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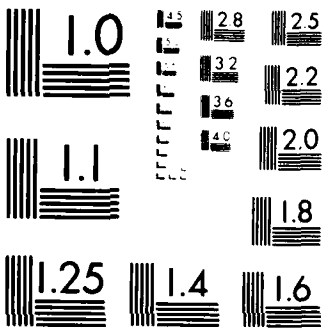
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M-X/MPS

ENVIRONMENTAL

TECHNICAL REPORT

AD-A149 903

PRELIMINARY FEIS

REVIEW COPY 2 OCTOBER 1981

ETR 13

ATMOSPHERIC RESOURCES

DEPLOYMENT AREA SELECTION
AND LAND WITHDRAWAL/
ACQUISITION

DEPARTMENT OF THE AIR FORCE

M-X ETR-13

ENVIRONMENTAL CHARACTERISTICS OF ALTERNATIVE DESIGNATED DEPLOYMENT AREAS: ATMOSPHERIC RESOURCES

Prepared for

United States Air Force
Ballistic Missile Office
Norton Air Force Base, California

By

Henningson, Durham & Richardson, Inc.
Santa Barbara, California

REVIEW COPY OF WORK IN PROGRESS

2 October 1981

DEPARTMENT OF THE AIR FORCE
WASHINGTON 20330

OFFICE OF THE ASSISTANT SECRETARY

Federal, State and Local Agencies

On October 2, 1981, the President announced his decision to complete production of the M-X missile, but cancelled the M-X Multiple Protective Shelter (MPS) basing system. The Air Force was, at that time, ~~of these decisions,~~ working to prepare a Final Environmental Impact Statement (FEIS) for the MPS site selection process. These efforts have been terminated and the Air Force no longer intends to file a FEIS for the MPS system. However, the attached preliminary FEIS captures the environmental data and analysis in the document that was nearing completion when the President decided to deploy the M-X system in a different manner. [illegible] Nevada, Utah, Tex[illegible] and New Mex[illegible]

The preliminary FEIS and associated technical reports represent an intensive effort at resource planning and development that may be of significant value to state and local agencies involved in future planning efforts in the study area. Therefore, in response to requests for environmental technical data from the Congress, federal agencies and the states involved, we have published limited copies of the document for their use. Other interested parties may obtain copies by contacting:

National Technical Information Service
United States Department of Commerce
5285 Port Royal Road
Springfield, Virginia 22161
Telephone: (703) 487-4650

Sincerely,

James F. Boatright

JAMES F. BOATRIGHT
Deputy Assistant Secretary
of the Air Force (Installations)

1 Attachment
Preliminary FEIS

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1.0 INTRODUCTION

DESCRIPTION OF THIS DOCUMENT

This document is intended to provide a more complete discussion of the air quality portion of the Environmental Impact Statement (EIS) for the M-X Missile System. The report is organized with a presentation of the existing and future (without the M-X) affected environment, followed by a discussion of the M-X air quality-related impacts.

Section 2.1, Existing Environment, discusses air quality, emissions data, air pollution meteorology, and climatology. To realistically evaluate the potential M-X-induced air quality impacts, the future air quality of the study area is addressed next. Sources that may degrade the air quality or will compete for available air resources (such as nonattainment area offsets) are addressed in Section 2.2, Future Environment without M-X.

The air quality models used are described in Section 3 in order to acquaint the reader with the characteristics and rationale for selection of each model. The type of emissions and meteorological data that each model requires as input is briefly described as well as the limitations and assumptions inherent in each. In order to predict impacts, estimates of M-X-related air pollutant emissions were made (Section 4.1). The formulas used to calculate emissions are given along with the emission estimates.

Meteorological data requirements used for each model calculation are given in Section 4.2. Since very sparse meteorological data were available for the study area, the pollutant dispersion conditions from nearby data sources were used as the basis for calculations.

Model results are given in Section 5. The results for the more complex three-dimensional wind flow IMPACT model are presented first followed by the simpler Gaussian dispersion and EPA-approved models (PAL and HIWAY). Results using the EPA-approved ISC model are presented last. This model was not available in time for its results to be incorporated into the Draft EIS summary document. The ISC modeling results are presented here as more realistic predictions of particulate concentrations than the PAL model provides. The regionally* modeled concentrations are presented for each hour modeled. The analysis of the modeling, with graphs, figures, and tables illustrating results, is more detailed than that presented in the draft EIS. Results are also discussed in light of the limitations of the models.

PURPOSE OF THE AIR QUALITY STUDY: REGULATORY FRAMEWORK

Extreme levels of air pollution have been found to cause human illness and even death. In addition, certain air pollution levels, while not primarily injurious to

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*In this case "regional" refers to the area extending throughout entire individual valleys.

human health, are damaging to the public welfare in terms of forest and crop damage, material and building corrosion, visibility degradation, and damage to personal property.

In order to reduce air pollution, Congress passed the Clean Air Act of 1963 (CAA) with many subsequent revisions, including the Air Quality Act of 1967, and the CAA Amendments of 1970 and 1977. The U.S. Environmental Protection Agency (EPA) is designated to enforce the CAA by providing regulatory guidelines and by helping the states to attain or maintain air quality standards.

National Ambient Air Quality Standards (NAAQS) were established by EPA for "criteria" pollutants; that is, for pollutants which were determined to be injurious to human health or welfare. "Primary" NAAQS were established to protect public health, while "secondary" standards were established to protect public welfare.

Under the Clean Air Act Amendments of 1970 and 1977, each state is required to prepare a State Implementation Plan (SIP) that contains proposed methods of attaining the NAAQS where nonattainment presently exists, and to maintain the NAAQS where air quality levels are better than the NAAQS. An area where air quality is better than a NAAQS for a particular pollutant is referred to as an "attainment" area for that pollutant. An area with violations of the NAAQS is called a "nonattainment" area for each pollutant in violation of the standard. An area can be considered an "attainment" area for certain pollutants and a "nonattainment" area for other pollutants.

NONATTAINMENT AREAS

The 1977 Amendments required that certain revisions to SIPs be made. Control strategies were required for each state outlining a plan for attaining the NAAQS by a specified date for any areas that had not attained the NAAQS by 1977.

The control strategy must include a plan for the siting of new sources in nonattainment areas to insure that the resulting air quality will improve rather than worsen.

ATTAINMENT AREAS: PREVENTION OF SIGNIFICANT DETERIORATION (PSD)

Attainment areas are classified as Class I, II, or III, and are subject to regulations designed for prevention of significant deterioration (PSD) of air quality. Significant concentration levels, or increments, that cannot be exceeded were established for sulfur dioxide (SO_2) and total suspended particulates (TSP) that vary for Class I, II, and III areas. Increments are smallest and most restrictive for Class I areas, less restrictive for Class II areas, and least restrictive for Class III areas (see Table 1-1).

In order to preserve the air quality in areas of special national or regional, recreational, scenic, or historic values, certain areas are officially designated as Class I. Mandatory Class I status was assigned by Congress to all international parks, national wilderness areas and memorial parks larger than 5,000 acres (2,000 ha), and national parks larger than 6,000 acres (2,400 ha) that were established at the time of the 1977 CAA Amendments. These mandatory Class I areas cannot be redesignated. Class III status can be assigned to major

Table 1-1. Maximum allowable air pollutant increases for SO_2 and TSP for "significant deterioration" under Clean Air Act Amendments of 1977.[1]

POLLUTANT	AVERAGING TIME	MAXIMUM ALLOWABLE INCREASES IN SO_2 AND TSP CONCENTRATIONS FOR PREVENTION OF SIGNIFICANT DETERIORATION ($\mu g/m^3$)		
		CLASS I	CLASS II	CLASS III
Sulfur Dioxide (SO_2)	Annual Mean	2	20	40
	24-Hour[2]	5	91	182
	3-Hour	25	512	700
Total Suspended Particulates (TSP)	Annual Mean	5	19	37
	24-Hour	10	37	75

730-1

[1]All areas are designated Class II except Mandatory Class I areas.

[2]The 3-hour and 24-hour SO_2 and TSP concentrations can be violated not more than once per year.

industrialized areas that have ambient SO_2 and TSP levels close to but below NAAQS. All remaining attainment areas are designated Class II.

The reclassification of certain Class II areas to Class I status is under review. Mandatory and proposed Class I areas in the M-X deployment area are discussed in Section 2.1.

PSD increments, or similar regulations for attainment areas of hydrocarbons, carbon monoxide, nitrogen oxides, and photochemical oxidants are currently being considered. Regulations protecting visibility in Class I areas were signed by the EPA Administrator on November 21, 1980. When implemented, these regulations will affect development in PSD Class I areas or in areas close to Class I areas where it is shown that the air quality or visibility in a Class I area will be affected.

REGULATED SOURCES UNDER PSD REGULATIONS

PSD preconstruction review is required for all new or modified major stationary sources in attainment areas. A major stationary source refers to any of 28 specified stationary sources which emit, or have the potential to emit, 100 tons per year or more of any criteria air pollutant or all other stationary sources which emit, or have the potential to emit, 250 tons per year of any criteria air pollutant. Criteria air pollutants are those pollutants which have NAAQS, including lead, particulate matter, carbon monoxide, photochemical oxidants, sulfur dioxide, nitrogen oxides, and non-methane hydrocarbons.

PSD preconstruction review procedures include (1) a case-by-case determination of the best available (air pollution) control technology (BACT) to be applied, (2) required background monitoring data, (3) a modeling study and discussion of the impacts of the proposed source on ambient air quality levels, (4) an assessment of the effects on visibility, soils, and vegetation, and (5) full public review.

REGULATED SOURCES UNDER NONATTAINMENT REGULATIONS

The control strategy for nonattainment areas must include a preconstruction permit review for all major stationary sources, a vehicle emission control inspection and maintenance program in carbon monoxide or photochemical oxidants non-attainment areas, and any other measure necessary to provide for attainment of the NAAQS. Other measures can include indirect source review; however, EPA does not require states to include indirect source review in their control strategies.

An "indirect source" is a facility, building, structure, or installation which attracts (or may attract) mobile service activity that results in emissions of a pollutant for which there is a NAAQS. Examples include highways and roads, and retail, commercial, and industrial facilities. The M-X operating base (OB) also represents an indirect source that is not subject to nonattainment.

M-X-RELATED AIR QUALITY PROBLEMS

M-X-related air pollutant effects will result primarily from area emission sources such as fugitive dust from construction activity and from gaseous emissions during the operations phase, due to indirect emission sources associated with the

operating base. Historically, the emphasis in federal and state air pollution regulations has been on controlling emissions and mitigating air quality impacts from major stationary, point emission sources rather than area sources, indirect sources, or temporary sources, such as those sources predicted to occur as a result of the M-X system, particularly with regard to PSD regulations in attainment areas. Consequently, modeling techniques that predict air quality impacts have been developed principally for predicting impacts from major stationary emission sources.

CONSTRUCTION

A primary air quality impact resulting from M-X system construction will be the fugitive dust emissions from construction activities such as earthmoving, sand and gravel processing, aggregate storage area operations, and the movement of trucks and other vehicles over unpaved surfaces. Fugitive dust emissions increase particulate concentrations in the atmosphere surrounding construction. The emission rate, size distribution of the particles emitted, and prevailing atmospheric conditions determine the resulting particulate matter concentrations. Fugitive dust emissions affect the construction workers on site, visitors to the area, and any nearby residents. Under favorable meteorological conditions, fugitive dust may be transported long distances from the construction site.

Increased particle deposition on surfaces downwind will occur from M-X fugitive dust emissions. The impact from dust will depend on the sensitivity of the area to deposition. For example, some biological or ecological communities will be more susceptible to damage from particle deposition than others. Fugitive dust can cause respiratory problems in livestock and wildlife, and can reduce vegetation growth by coating plant surfaces. Also, nearby residences will experience particle deposition impacts varying from mild inconvenience, such as increased dust on windows, to major effects such as siltation of ponds. The severity of impact depends on the construction activity rate, local atmospheric conditions, and distance from the site.

Particle content in the atmosphere also affects visibility. PSD regulations require that visibility impairment in Class I areas caused by any permanent major stationary source must be evaluated prior to project approval. Temporary emissions include (but are not limited to) those from a portable facility, construction, or exploration facilities lasting less than two years at one site (45 Fed. Reg. 52719, August 7, 1980). Current plans for the M-X system do not include the installation of any permanent major stationary sources with the exception of a potential central cooling and heating facility (CCHF). However, M-X construction emission sources may cause temporary visibility impairment at those Class I areas less than 40 mi from the deployment area and perhaps at Class I areas even farther than 40 mi from construction activity.

Long range transport of smaller dust particles can cause temporary visibility impacts at significant distances (beyond 40 mi) from the construction site. Smaller particles are more highly correlated with visibility impairment so that the impact on visibility will depend largely on the size distribution of the dust emissions. Fine solid or liquid particles whose diameters range from 0.1 to 1.0 microns are the most effective size per unit mass in affecting visibility by scattering light (Latimer et al., September 1978). Fine particles also remain suspended in air longer and for greater transport distances than larger particles.

Evaluation of visibility impairment from elevated point sources is the principle focus of current research directed by EPA. Predicting visibility impairment from area-wide, ground-level sources is much more difficult and less well understood. Visibility effects from fugitive dust emissions are qualitatively addressed here, but could require further site-specific investigations.

Other air quality impacts are predicted due to gaseous emissions from M-X system construction vehicles, equipment, and generators used to provide power for material processing activities. Gaseous emissions from construction vehicles will cause increases in ambient gaseous pollutant levels near roadways. The impact from these emissions will depend on the degree of exposure to vegetation and the public.

In the Nevada/Utah region, other elements that may be released from the ground level emissions of construction activity include surface deposits of substances such as some possibly carcinogenic zeolite mineral species. (Refer to the Geological Resources Technical Report, ETR-11, and the Public Health Concerns Technical Report, ETR-43 for detailed information on zeolites, their occurence in the study area, and alleged health hazard.)

There is also a concern that radioactive deposits in the soil of the Nevada/Utah area disturbed by construction activity will cause hazardous health conditions to the workers and nearby residents. This potential problem is currently being studied and is discussed in the Public Health Concerns Technical Report, ETR-43.

OPERATION

During operation of the M-X system, air pollutant emissions occur at the operating base and to a smaller degree in the deployment area. Operating base emissions include gaseous and particulate emissions from vehicles and gaseous emissions from space heating and cooling. Other emissions sources will include small industrial sources and possibly a central cooling and heating facility (CCHF) CO (carbon monoxide) and NO_x (nitrogen oxides) emissions will cause elevated pollutant levels in local emission hot spots, such as in areas adjacent to congested or busy roadways. HC (hydrocarbons) will be emitted from vehicles, aircraft, and fuel storage areas. The NAAQS for HC were established as a guideline for attaining the O_3 (ozone) standard.

Emissions in the deployment area during operation, outside of the operating base, will include fugitive dust from surfaces left exposed after construction and from occasional vehicular traffic over the unpaved cluster roads.

2.0 ATMOSPHERIC RESOURCES

2.1 EXISTING ENVIRONMENT

NEVADA/UTAH (2.1.1)

The Nevada/Utah basing area is primarily a plateau with numerous mountain ranges and a well-defined ridge and valley system. The region contains desert or semidesert lands owing to its location just east and leeward of the Sierra Nevada Range. Moist air associated with Pacific Ocean storms ascends the western slopes of the Sierras where a large part of the moisture falls as precipitation. As the air descends the eastern slope, it is warmed by compression, resulting in little or no precipitation. Because of the large variation in elevation between mountains and valleys there are large local variations of temperature and rainfall. In general the most significant climatic features of the region are considerable sunshine, small annual precipitation in the valleys, heavy snowfall in the higher mountains, low relative humidity, and extreme daily ranges of temperature.

Temperature

Temperatures in the Nevada/Utah basing region are highly variable both seasonally and diurnally. Normal daily maximum temperatures range from the 30s and 40s (degrees F) in January to the 80s and 90s in July. Minimum temperatures tend to range between 10 to 20 degrees F in January to the 40s and 50s in July. The mean daily temperature range is large, especially in the summer when it varies 25 to 40 degrees F. The temperature ranges are especially large in the valleys because of cold air drainage from the mountains at night. The minimum temperature at a valley floor is generally 5 to 10 degrees F lower than at higher elevations and can be as much as 30 degrees F lower.

Precipitation

The Nevada/Utah area has, in general, low annual average precipitation levels, with a widely varying precipitation pattern. Precipitation amounts depend on elevation. Higher elevations tend to receive more precipitation than do the lower elevations. Figure 2.1.1-1 shows the annual average precipitation pattern for the Nevada/Utah region based primarily on weather stations located at lower altitudes. Amounts are distributed relatively uniformly throughout the year. The records at Ely, Nevada, show a slight precipitation maximum during the spring while Caliente, Nevada, has a summer maximum. The recording weather stations in Utah indicate a tendency towards a spring precipitation maximum. A more detailed discussion of precipitation is contained in the Water Resources Technical Report, ETR-12.

Wind Speed, Wind Direction, and Mixing Heights

In general, the dispersive ability of the atmosphere in the Nevada/Utah basing area is good. The seasonal and annual averaged morning and afternoon mixing heights and wind speeds appear in Table 2.1.1-1. Afternoon mixing heights are large, particularly during the spring through autumn seasons, and wind speeds are relatively brisk. Morning mixing heights are low in the Nevada/Utah region. This is a result of nocturnal radiation inversions and frequent cold air drainage into the

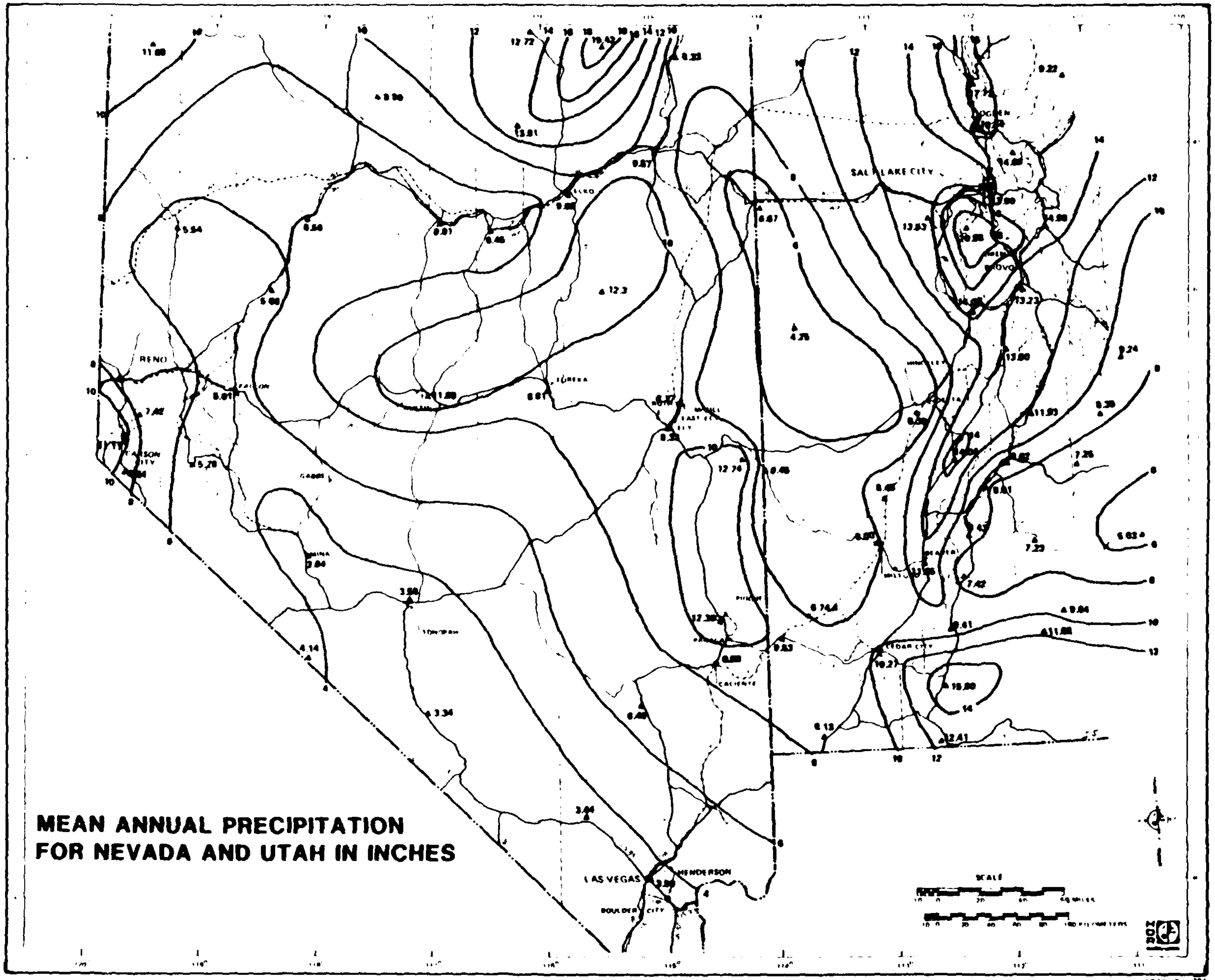

Figure 2.1.1-1. Mean annual precipitation for Nevada/Utah, in inches.

Table 2.1.1-1. Mixing heights and wind speeds for stations in Nevada/Utah.

Station	Time	Winter		Spring		Summer		Autumn		Annual	
		HT[1]	U[2]	HT	U	HT	U	HT	U	HT	U
Ely, NV	Morning	193	5.1	489	5.1	109	4.2	161	4.5	238	4.7
	Afternoon	1,072	5.5	2,708	7.4	3,624	7.0	2,179	6.1	2,396	6.5
Las Vegas, NV	Morning	321	4.5	433	5.6	292	4.7	276	4.3	331	4.8
	Afternoon	1,153	4.2	2,785	7.1	3,693	6.7	2,106	5.2	2,434	5.8
Winnemucca, NV	Morning	301	3.3	434	4.1	129	2.7	255	3.4	280	3.4
	Afternoon	1,067	4.9	2,756	6.8	3,656	6.2	2,150	5.4	2,407	5.8
Salt Lake City,	Morning	329	4.3	419	5.4	216	4.6	238	4.6	300	4.7
UT	Afternoon	944	4.6	2,675	6.6	3,737	6.2	1,933	5.5	2,322	5.7

T829/8-26-81

[1] Mixing height given in meters.

[2] Wind speeds are averaged through the mixed layer and are in units of meters per second.

Source: Holzworth, G.C. 1972. "Mixing heights, wind speeds, and potential for urban air pollution throughout the contiguous United States," USEPA, Office of Air Programs, RTPNC, January.

valleys producing surface-based temperature inversions. These inversions break up a few hours after sunrise as surface heating by the sun causes vertical mixing in the atmosphere.

The prevailing surface wind direction in the Nevada/Utah region is from the south and southwest. However, it is the mountain and valley topography that most strongly influences local wind speed and direction. Because of the north-south orientation of the mountain ranges the surface winds in the valleys tend to be predominantly from the north or south. This pattern can be modified at night by downslope winds produced by cool, dense air flowing from higher elevation towards the valley floor. In the morning, east-facing mountain slopes heat up because of their orientation to the sun and induce upslope winds. This upslope wind is generally dominated by winds blowing up and down the valley as the day progresses and the valley heats up.

Stability

Atmospheric stability varies considerably both seasonally and diurnally in the basing region. The frequency of stability categories is summarized in Table 2.1.1-2. The frequent occurrence of stable conditions in Nevada/Utah is due to persistent high pressure subsidence and cold air drainage into the valleys as well as the extreme amount of nocturnal radiational cooling. The occurence of "episodes" of high pollutant concentrations is dependent on the persistence of stable conditions. Persistent stable conditions are most probable in the winter when low sun angles provide for lower solar radiation which may not be able to effectively break up the nocturnal inversion.

Dust Storms

Due to an arid climate, dry soils, and occasional strong winds in the basing region, dust can be mixed high into the atmosphere. At times, concentrations of this natural windblown dust can be of a sufficient magnitude to severely restrict visibility. Table 2.1.1-3 contains data on the frequency of dust observations for the basing region. The area most frequently experiences dust in the months of March and April. This is primarily due to the fact that maximum wind speeds for the year occur during these months.

Baseline Particulate Pollution

Particulate matter is designated by the Federal Environmental Protection Agency as one of the "criteria" pollutants. Criteria pollutants are those which could be factors in affecting human health. For this reason, criteria pollutants are carefully monitored, and have ambient air quality standards which legally cannot be exceeded. Particulate matter is defined as any solid or liquid particles dispersed in the air. This does not include water vapor or water droplets, but does include dust, pollen, ash, soot, metal particles, or chemical droplets. Collectively, this group is known as "total suspended particulates" (TSP).

Particulate pollutants may originate from one of two sources: natural or anthropogenic (man-originated). Natural sources include forest fires, volcanoes, sandstorms, and windblown dust. Windblown dust from erosion of the soil surface will be of primary concern when considering particulate emissions in the M-X

Table 2.1.1-2. Average range of frequency of stability conditions in Nevada.

Season	Percent Frequency of Stability Conditions[1] Nevada		
	Stable	Neutral	Unstable
Winter	30-40	45-55	5-15
Spring	25-35	40-50	15-25
Summer	30-40	30-40	25-35
Autumn	40-50	30-40	20-30
Annual	30-40	35-45	20-30

T5278/8-28-81

[1] "Unstable" defined as Pasquill categories A, B, and C, "Neutral" as Pasquill category D, and "Stable" as Pasquill categories E, F, and G.

Source: Doty, S.R., and B. L. Wallace, 1976: "A climatological analysis of Pasquill Stability categories based on 'Star' summaries, prepared by NOAA Environmental Data Service, National Climatic Center, April.

Table 2.1.1-3. Monthly percent frequency of dust observations in the Nevada/Utah regions.

Month	Percent Frequency[1]				
	Elko, Nevada	Ely, Nevada	Wendover, Utah	Dugway, Utah	Milford, Utah
January	0.055	0.036	0.044	0.100	0.054
February	0	0.038	0.072	0.300	0.184
March	0.055	0.053	0.102	0.800	0.488
April	0.229	0.254	0.022	0.700	0.656
May	0.174	0.018	0.142	0.700	0.502
June	0.016	0.018	0.023	0.300	0.183
July	0.320	0.530	0	0.100	0
August	0	0	0.033	0.100	0
September	0.025	0.019	0.022	0.200	0.030
October	0.103	0.055	0.052	0.100	0.144
November	0	0.19	0	0.100	0
December	0.034	0.081	0	0.038	0.101
Annual Average	0.061	0.054	0.042	0.300	0.200

T5295/9-23-81/F

[1]The percentage of hourly weather observations in which dust is reported as a restriction to visibility. This occurs when visibility is less than 7 miles and dust is reported in the hourly weather observation.

Source: Orgill and Sehmel, 1975.

deployment areas. Other natural sources by their very nature only occur on an intermittent basis, although they are considered as a steady-state effect in determining baseline conditions.

The anthropogenic sources of particulates are primarily related to transportation (land vehicles, aircraft, and water vessels); fuel combustion (residential, electric generation, industrial, and commercial-institutional); industrial processing (chemical, food, metals, minerals, petroleum, wood, leather, textiles, and others); solid waste disposal; agricultural tilling; construction activity; and dust from streets and unpaved roads. The various anthropogenic sources may be further categorized with respect to one of two possible types of origin--point or area source. A point source is defined as an individual emission source which is stationary, such as a structure, building, or facility. Area sources are all emission sources not identified as point sources. For example, area sources include all mobile sources, such as motor vehicles and aircraft, and groups of small, stationary, retail operations, such as gasoline service stations. Generally, total emission levels for specific categories of area sources have to be estimated. These estimates may be made using an appropriate emission factor and activity level as outlined in EPA publication No. AP-42 "Compilation of Air Pollutant Emission Factors," revised May 1978 (hereafter referred to as AP-42). An emission factor is a statistical average of the rate at which a pollutant is released to the atmosphere, divided by the level of the producing activity. Because the emission factor is a statistical average, its use may not be appropriate for establishing the baseline particulate concentrations or the amount of expected new emissions in the M-X deployment areas. These values will be better established by the acquisition of preconstruction and construction site-specific monitoring data. The emission factors may be used, however, to provide useful estimates of background levels and to describe the general magnitude of M-X-related emissions. In this manner, preliminary judgments of impact may be made prior to the complete analysis of actual onsite data. Further, an air quality monitoring network will provide valuable information relating to the exact nature of the particulate emissions, the atmospheric conditions, and the resulting effect on air quality caused by deployment of the M-X system.

Sources (Emissions)

In order to effectively assess the impact of particulate emissions created by the M-X project, it is necessary to first establish a background particulate level for each deployment area in question. The background level for each hydrographic sub-basin in the Nevada deployment area can be established by use of the data in Table 2.1.1-4. This table contains the most recent data available from the state of Nevada and represents values which have been either directly measured, or estimated using techniques appropriate to conditions for Nevada. Included in the table are measurements of stationary, mobile, and fugitive dust sources in tons/year. The stationary sources include particulate emissions from residential, commercial, and industrial fuel combustion; industrial processing; and general burning. Mobile sources are rail, air, auto, and off-highway vehicles. The fugitive dust category comprises sources of dust released from construction activity, from normal streets, unpaved roads, sand/gravel roads, and agricultural activity. Natural, windblown, fugitive sources are included as a separate heading in the fugitive dust category. It is noted that with the exception of three basins; Grass (No. 138), Monitor Southern (No. 140B), and Panaca (No. 203), the natural fugitive sources contribute a higher percentage of fugitive dust release than all the other fugitive

Table 2.1.1-4. Baseline particulate emission levels in Nevada (Page 1 of 2).

HYDRO-GRAPHIC SUB-BASIN	STATIONARY SOURCES (TONS/YR)	MOBILE SOURCES (TONS/YR)	FUGITIVE DUST SOURCES (TONS/YR)		TOTAL* (TONS/YR)	TOTAL (TONS/YR)	AREA (MI)²	DENSITY = TOTAL*/AREA (TONS/YR)	DENSITY = TOTAL/AREA (TONS/YR)
			NATURAL	OTHER					
47	.8	.9	2,634	1,358.3	1,360	3,994	787	1.73	5.07
53	.6	2.2	4,614	1,281.1	1,284	5,898	1,002	1.28	5.89
54	196.0	.3	3,790	727.5	924	4,714	752	1.23	6.27
55	69.1	.1	2,404	209.0	278	2,682	376	.74	7.13
56	2.9	3.7	3,425	2,363.7	2,370	5,795	1,138	2.08	5.09
57	.2	.0	3,276	171.9	172	3,448	452	.38	7.63
58	.1	.8	2,241	405.4	406	2,647	319	1.27	8.30
121	109.2	54.4	53,614	6,612.0	6,776	60,390	2,182	3.11	27.68
122	12,186.2	2.7	35,744	3,185.0	15,374	51,118	1,277	12.04	40.03
124	.0	.9	4,021	259.8	251	4,272	285	.88	14.99
125	.0	.0	625	54.5	55	680	43	1.28	15.81
126	.0	.4	1,453	34.0	34	1,487	110	.31	13.52
127	.1	.7	2,052	192.3	193	2,245	216	.89	10.39
128	.8	1.0	53,727	2,520.8	2,523	56,250	1,303	1.94	43.17
129	.4	.4	29,345	1,831.3	1,832	27,513	742	2.47	37.08
130	.0	.0	4,242	68.0	68	4,310	142	.48	30.35
133	.1	1.4	15,146	278.3	280	15,426	416	.67	37.08
134	.1	.6	2,275	72.5	73	2,348	582	.13	4.03
135	.1	.1	1,601	702.0	702	2,303	460	1.53	5.01
136	.0	.0	1,777	165.0	165	1,942	284	.58	6.84
137A	13.4	9.3	8,698	1,874.0	1,894	10,593	1,603	1.18	6.61
137B	1.0	5.3	9,913	2,574.6	2,580	12,494	1,323	1.95	9.44
138	.1	1.3	4,306	6,275.0	6,276	10,582	595	10.55	17.79
139	.0	2.1	6,129	721.4	724	6,853	868	.84	7.89
140A	.1	.1	2,996	447.7	448	3,444	529	.85	6.51
140B	.1	.5	2,483	3,464.0	3,465	5,948	509	6.81	11.68
141	.1	3.1	10,930	4,293.1	4,296	15,226	971	4.42	15.68
142	1.5	4.5	4,612	689.4	695	5,307	313	2.22	16.96
143	1.0	.6	6,895	1,263.3	1,265	8,160	555	2.28	14.70
144	.1	4.3	7,304	447.0	451	7,755	535	.84	14.50
145	.0	.0	71,024	16.7	17	71,041	381	.04	186.46
148	.0	.0	69,920	36.6	37	69,957	403	.09	173.59
149	.1	1.0	147,143	501.7	503	147,646	985	.51	149.89
150	.0	.0	32,659	141.5	142	32,800	434	.33	75.58
151	.1	.0	6,242	207.9	208	6,450	444	.47	14.53
152	.0	.0	189	16.2	16	205	17	.94	12.06
153	4.6	4.2	9,442	1,473.0	1,482	10,923	752	1.97	14.53
154	.2	2.0	13,827	1,138.6	1,141	14,968	801	1.42	18.69
155A	18.2	.7	9,199	786.1	805	10,003	591	1.36	16.93
155B	.0	.1	692	80.5	81	773	57	1.41	13.55
155C	.0	.4	6,440	251.3	252	6,692	510	.49	13.12
156	.2	.8	136,391	382.8	384	136,775	1,036	.37	132.02
158A	.0	.0	113,374	16.3	16	113,390	663	.02	171.03
169A	.0	.2	97,398	184.3	185	97,583	618	.30	157.90
170	.0	.2	114,373	449.8	450	114,823	700	.64	164.03
171	.0	.0	80,203	161.0	161	80,364	460	.35	174.70
172	.2	.0	69,497	221.7	222	69,719	493	.50	141.42
173A	.1	.3	95,627	226.6	227	95,854	603	.38	158.96
173B	1.1	1.8	268,565	2,708.6	2,716	271,277	2,149	1.26	126.23
174	.0	1.5	5,829	426.4	428	6,257	422	1.01	14.83
175	.0	.1	9,002	489.0	489	9,491	651	.75	14.58
176	1.4	1.4	5,437	3,187.6	3,190	8,627	1,004	3.18	8.59
178A	.1	.6	1,126	471.8	473	1,599	269	1.76	5.94
178B	.1	.3	12,770	1,877.9	1,878	14,648	739	2.54	19.82

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Table 2.1.1-4. Baseline particulate emission levels in Nevada (Page 2 of 2).

HYDRO-GRAPHIC SUB-BASIN	STATIONARY SOURCES (TONS/YR)	MOBILE SOURCES (TONS/YR)	FUGITIVE DUST SOURCES (TONS/YR)		TOTAL* (TONS/YR)	TOTAL (TONS/YR)	AREA (MI)^2	DENSITY = TOTAL*/AREA (TONS/YR)	DENSITY = TOTAL/AREA (TONS/YR)
			NATURAL	OTHER					
179	19,074.2	26.2	43,758	9,807.3	28,908	72,666	1,942	14.88	37.42
180	.0	.0	3,999	200.3	200	4,199	362	.55	11.60
181	.0	1.4	8,613	2,989.3	2,991	11,604	882	3.39	13.16
182	.0	.7	4,505	416.1	417	4,922	383	1.09	12.85
183	.5	2.4	3,430	414.8	418	3,848	557	.75	6.91
184	1.0	3.4	33,306	2,136.9	2,142	35,448	1,661	1.29	21.34
185	.0	.1	11,748	469.2	469	12,217	345	1.36	35.41
186A	.0	.0	4,937	113.7	114	5,051	125	.91	40.41
186B	.0	.7	9,481	212.6	213	2,694	270	.79	35.90
187	.2	7.7	6,885	945.2	953	7,838	954	1.00	8.52
194	.0	.0	1,278	53.7	54	1,332	75	.72	17.76
196	.0	.0	3,224	253.3	253	3,477	413	.61	8.41
198	.1	.1	662	137.4	138	800	113	1.23	7.08
199	.0	.1	76	50.3	50	126	12	4.20	10.53
200	.3	.1	347	123.2	124	471	52	2.38	9.05
201	.0	.2	1,296	635.7	636	1,932	287	.43	6.73
202	3.9	3.6	2,772	441.8	449	3,221	418	1.07	7.71
203	387.3	4.2	2,066	2,664.2	3,056	5,124	334	9.15	15.34
204	2.3	.6	30,451	968.3	971	31,422	364	2.67	86.32
205	4.4	2.2	166,581	2,603.8	2,610	169,919	979	2.67	172.82
206	.0	.0	25,037	70.4	70	25,107	234	.31	107.30
207	4.3	3.2	13,898	1,969.2	1,977	15,874	1,607	1.23	9.88
208	.0	.1	71,851	460.4	460	72,311	508	.91	142.35
209	2.9	5.1	122,499	969.1	977	123,476	768	1.27	160.78
210	.0	4.4	115,445	137.4	142	115,587	657	.22	175.93
216	.0	22.7	31,354	360.9	384	31,738	156	2.46	203.45
217	.0	.0	15,337	.0	1	15,337	80	.00	191.71
218	.8	16.5	61,180	5,092.4	5,110	66,290	318	16.07	208.46
219	.1	1.2	15,089	361.6	363	15,452	91	3.99	169.80
220	6.0	14.9	42,450	1,188.3	1,209	43,659	252	4.80	173.25
221	.0	.0	20,019	101.1	101	20,120	192	.53	104.79
222	3.4	17.8	146,105	952.3	973	147,078	907	1.07	162.16

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*Does not include Natural Fugitive Dust Sources.

dust sources combined. The amount of natural fugitive dust is greater than all other dust sources by a factor of 1.4 in the Upper Reese River Basin (No. 56) to 15,000 in the Hidden-North Basin (No. 217).

The particulate emission data from Nevada is unique in that it is delineated by hydrographic subbasin. This is ideal for purposes of impact assessment on a valley-by-valley basis because each subbasin essentially encompasses one (sometimes two) valley regions. Assessment of a community or specific area within a valley would generally be based on the assumption of homogeneous conditions throughout a given valley, particularly for long-term type effects. Unfortunately, though, this level of data is not available for the M-X study region of Utah, where the analysis on a valley-by-valley basis would also be the most informative. A 1976 emissions inventory which gives source category emissions by county was used. (See Table 2.1.1-5). Included as source categories are highway vehicles, off-highway vehicles, and other transportation (mobile sources); process industries, solid waste burning, space heating, and electric power generation (stationary sources); and dirt roads and forest fires (fugitive dust sources). Three categories of important fugitive dust sources which were found in the Nevada data are missing from the Utah data: construction activity, dust from agricultural activity, and natural windblown sources. It may be that construction and agricultural dust emissions within Utah are insignificant in relation to other emissions. These two activities need to be examined in order to determine if their emissions are a significant effect. The third category, windblown sources, has already been determined to be a major source in Nevada (see Table 2.1.1-4).

Assessment of background particulate emission denisty may be made, on a comparative basis between states, from information contained in the 1977 National Air Quality, Monitoring and Emissions Trends Report. Data from this report are presented as TSP emission density maps for the Nevada/Utah area (see Figure 2.1.1-2). Note that the highest background particulate emission density to be found in the deployment areas of the states is less than 10 tons/sq mi. These levels do not, however, include particulate emissions from fugitive dust sources for either state.

Air Quality Levels

State and National Ambient Air Quality Standards (NAAQS) for particulates applicable in Nevada and Utah are shown in Table 2.1.1-6. Primary and secondary standards are the air quality levels necessary to protect the public's health and welfare, respectively. The particulate standards are defined as Total Suspended Particulate (TSP) concentrations averaged for a 24-hour and annual period. States may implement standards that are more strict than the NAAQS. Nevada adopted a more strict primary TSP 24-hour standard that is equal to the National secondary 24-hour standard. Utah has not adopted other standards so only the NAAQS apply in Utah.

Areas that have attained the NAAQS are classified as attainment areas. Proposed sources in attainment areas must comply with Prevention of Significant Deterioration (PSD) regulations. Under PSD regulations, attainment areas are categorized as Class I, II, or III areas. TSP levels in Class I, II, and III areas are allowed to be degraded only by a specified increment. (see Table 1-1).

Table 2.1.1-5. Utah particulate emission inventory by county. (Page 1 of 2)

REGION/COUNTY	STATIONARY SOURCES (TONS/YR)	MOBILE SOURCES (TONS/YR)	FUGITIVE DUST SOURCES (TONS/YR)	TOTAL (TONS/YR)
AQCR 14 FOUR CORNERS				
Emery	1,012	108	1,666	2,786
Garfield	323	501	1,773	2,597
Grand	646	111	1,720	2,477
Iron	566	196	3,038	3,800
Kane	67	49	1,138	1,254
San Juan	303	64	4,239	4,606
Washington	164	103	1,749	2,016
Wayne	247	14	1,799	2,060
AQCR 220 WASATCH FRONT				
Davis	570	625	394	1,589
Salt Lake	15,996	2,059	366	18,421
Tooele	4,994	230	2,310	7,534
Utah	8,088	630	1,672	10,390
Weber	2,074	616	284	2,974
AQCR 219 INTRA STATE				
Beaver	139	75	1,874	2,088
Box Elder	485	333	2,900	3,718
Cache	229	169	1,533	1,931
Carbon	3,728	104	1,034	4,866
Daggett	25	10	485	520
Duchesne	282	89	1,682	2,053
Juab	493	115	2,402	3,010
Millard	310	131	4,100	4,541

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Table 2.1.1-5. Utah particulate emission inventory by county. (Page 2 of 2)

REGION/COUNTY	STATIONARY SOURCES (TONS/YR)	MOBILE SOURCES (TONS/YR)	FUGITIVE DUST SOURCES (TONS/YR)	TOTAL (TONS/YR)
AQCR 219 INTRA STATE (continued)				
Morgan	169	59	169	397
Piute	109	20	690	819
Rich	68	14	1,001	1,083
Sanpete	919	89	1,200	2,208
Sevier	1,131	127	1,263	2,521
Summit	329	150	308	787
Uintah	430	71	1,385	1,886
Wasatch	61	85	720	866

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Source: State of Utah Emissions Inventory, 1976.

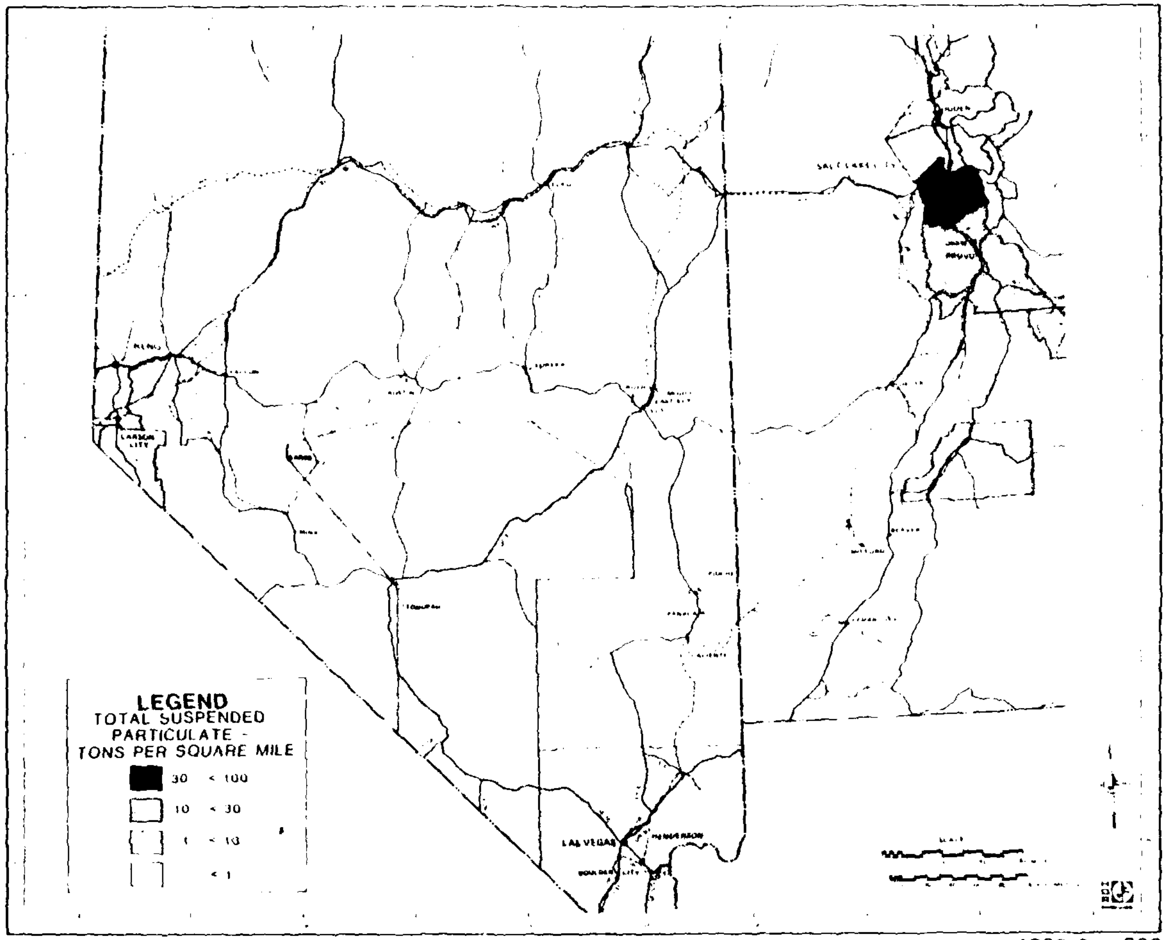

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Figure 2.1.1-2. Suspended particulate emissions in the Nevada/ Utah study area.

Table 2.1.1-6. Summary of National Ambient Air Quality Standards (NAAQS) and Nevada/Utah[1] ambient air quality standards for total suspended particulates (TSP) and lead (Pb).

Pollutant	Averaging Time	NAAQS		Nevada Standards
		Primary	Secondary[2]	Primary
Total Suspended Particulate Matter	Annual (Geometric Mean)	75 $\mu g/m^3$	60 $\mu g/m^3$	75 $\mu g/m^3$
	24-hour[3]	260 $\mu g/m^3$	150 $\mu g/m^3$	260 $\mu g/m^3$
Lead	Quarterly (Arithmetic Mean)	1.5 $\mu g/m^3$	Same as primary standard	Same as NAAQS

T728/10-2-81

[1] All Utah standards are equivalent to NAAQS.

[2] Secondary annual TSP standard (60 $\mu g/m^3$) is a guide for assessing state implementation plans.

[3] Not to be exceeded more than once per year.

Mandatory Class I areas and those proposed for redesignation from Class II to Class I status, are shown in Figure 2.1.1-3. All other areas in attainment are designated Class II. The Class I areas of greatest importance given the proximity to the M-X system and prevailing transport wind direction are Zion, Bryce Canyon, and Capitol Reef National Parks.

Nevada's nonattainment areas are designated by hydrographic basin, urban, or industrial area. Utah's nonattainment areas are designated by county, urban, or industrial area. Nonattainment areas in Nevada and Utah are shown in Figure 2.1.1-3. Areas in Figure 2.1.1-3 designated as "unclassified" are those in which an air quality problem is suspected, but cannot be classified either nonattainment or attainment because of insufficient data.

Annual and second highest 24-hour TSP levels in 1977 are given in Figure 2.1.1-4.

Background TSP levels are measured at several sites in the deployment area. These monitors are located in rural or remote areas and are not affected by anthropogenic TSP emission sources. A background monitor at Tonopah and Lehman Caves, Nevada, show TSP levels far below the annual or 24-hour NAAQS. Similar background levels can be assumed to occur in valleys of the deployment area without anthropogenic TSP emission sources.

TSP Seasonal Variation

Annual and quarterly TSP mean values for Lehman Caves, Nevada, are given in Table 2.1.1-7. Lehman Caves is considered a background monitor by the Nevada Department of Environmental Protection. Little annual variation has occurred during the four-year monitoring period (1974-1977). TSP quarterly variation does occur. Highest particulate levels occur during the drier summer months (July to September). Lowest particulate levels occur during the wetter winter and spring months (January to March). Other sites show maximum dust frequencies in March and April, see Table 2.1.1-3.

Baseline Gaseous Pollutants

Sources (Emissions)

Baseline gaseous pollutant levels are difficult to establish for each of the deployment areas within the states of Nevada and Utah as few measurements exist.

The Utah gaseous pollutant emission data available are for values of SO_x (sulfur oxides), CO (carbon monoxide), HC (hydrocarbon) and NO_x (nitrogen oxides) on a county-by-county basis from the state of Utah. Data are compiled in the 1978 "Summary of Air Pollution Source Emission Calculations from Utah," which was prepared using 1976 data (see Tables 2.1.1-8 through 2.1.1-11). The source categories listed in the tables are:

- o mobile sources - which include highway vehicles, off-highway vehicles, and other transportation
- o stationary sources - which include process industries, solid waste burning, space heating, and electric power generation

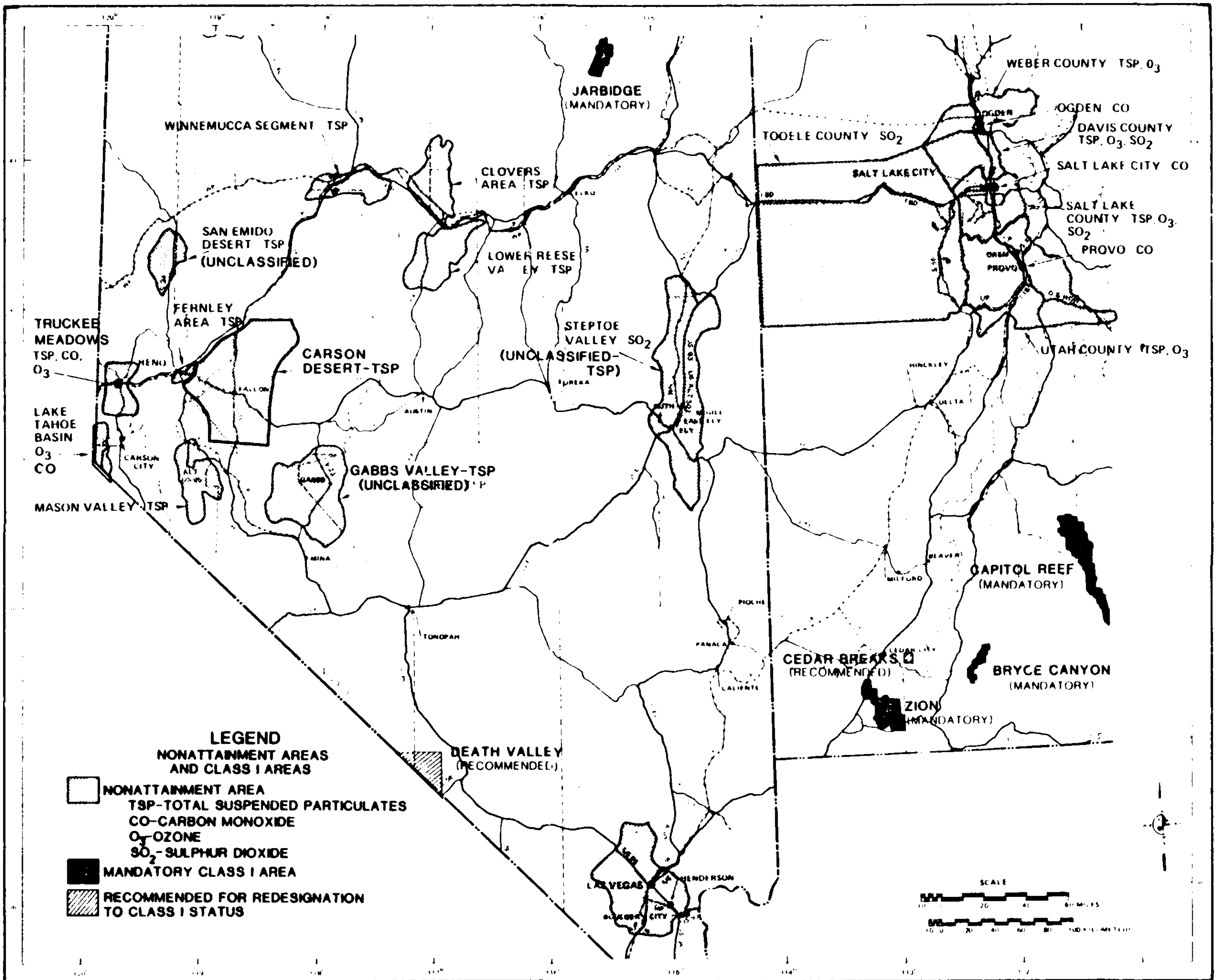

Figure 2.1.1-3. Class I areas and nonattainment areas in Nevada/Utah.

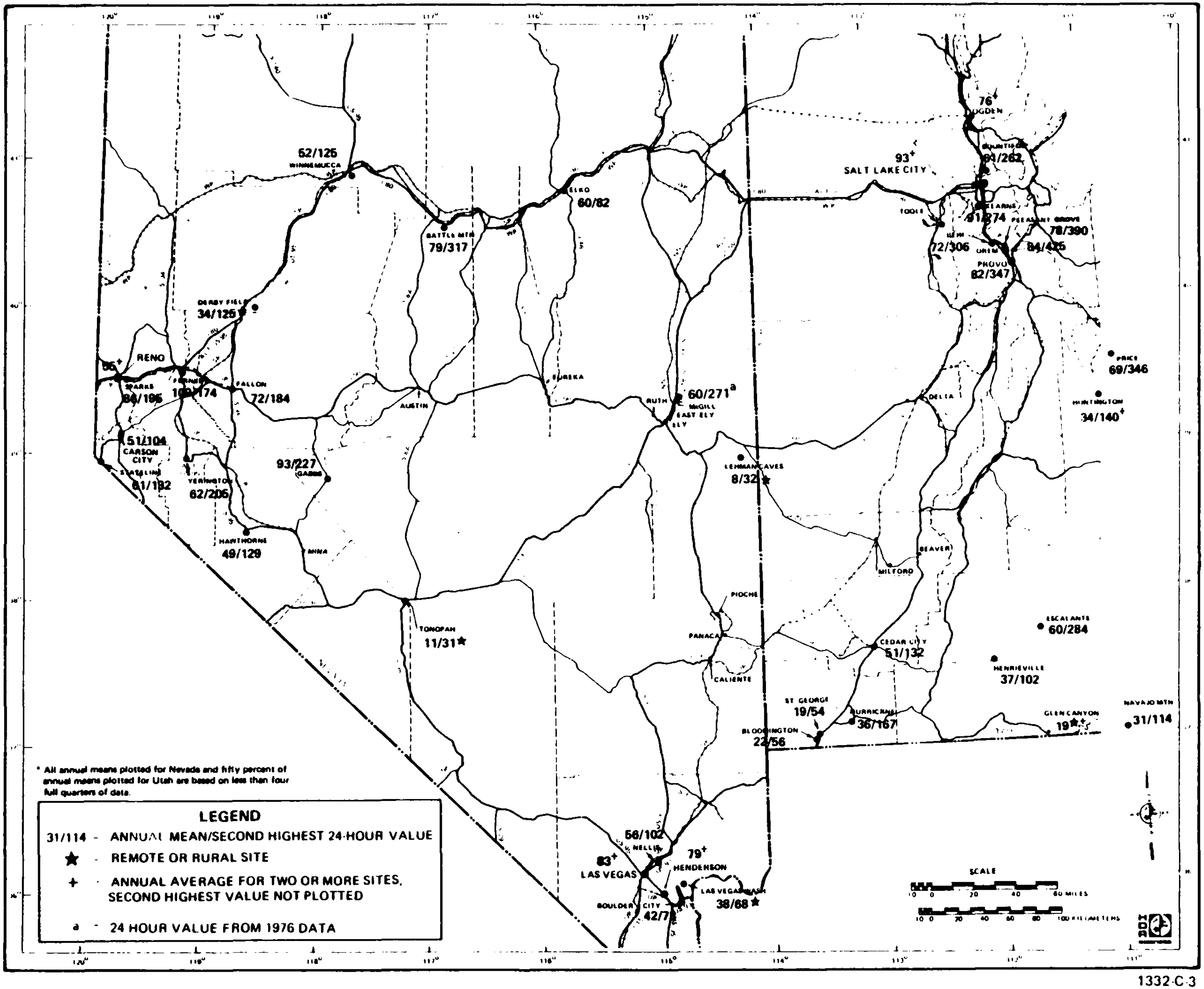

Figure 2.1.1-4. Total suspended particulate levels (micrograms/cubic meter) in Nevada/Utah (1977).

Table 2.1.1-7. Annual and quarterly total suspended particulate levels at Lehman Caves, Nevada, 1974-1977 (micrograms per cubic meter).

YEAR	ANNUAL	FIRST QUARTER	SECOND QUARTER	THIRD QUARTER	FOURTH QUARTER
		JANUARY-MARCH	APRIL-JUNE	JULY-SEPTEMBER	OCTOBER-DECEMBER
1974	6.3	3.9*	9.3	10.3	2.8
1975	8.4	4.4	11.2	12.6	8.8
1976	8.4	3.4	10.3	13.1	13.1*
1977	8.2	5.6	8.6	11.5	7.1
4-Year Average	7.8	4.3	9.9	11.9	8.0

729-1

* 50 percent or less of sampling days recorded.

Table 2.1.1-8. Utah SO_x emission inventory by county. (Page 1 of 2)

REGION/COUNTY	STATIONARY SOURCES (TONS/YR)	MOBILE SOURCES (TONS/YR)	NATURAL SOURCES (TONS/YR)	TOTAL (TONS/YR)
AQCR 14 FOUR CORNERS				
Emery	7,992	123	0	8,115
Garfield	97	35	0	132
Grand	94	122	0	216
Iron *	801	173	0	974
Kane	38	34	0	72
San Juan	88	49	0	137
Washington	150	76	0	226
Wayne	48	10	0	58
AQCR 220 WASATCH FRONT				
Davis	4,944	301	0	5,245
Salt Lake	18,610	1,505	0	20,115
Tooele *	997	228	0	1,225
Utah	8,845	490	0	9,335
Weber	853	547	0	1,400
AQCR 219				
Beaver *	71	87	0	158
Box Elder	782	295	0	1,077
Cache	628	157	0	785
Carbon	11,608	129	0	11,737
Daggett	16	8	0	24
Duchesne	137	67	0	204
Juab *	153	119	0	272
Millard *	162	132	0	294

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Table 2.1.1-8. Utah SO_x emission inventory by county. (Page 2 of 2)

REGION/COUNTY	STATIONARY SOURCES (TONS/YR)	MOBILE SOURCES (TONS/YR)	NATURAL SOURCES (TONS/YR)	TOTAL (TONS/YR)
AQCR 219				
(continued)				
Morgan	1,200	78	0	1,278
Piute	38	14	0	52
Rich	32	11	0	43
Sanpete	342	107	0	449
Sevier	465	148	0	613
Summit	171	114	0	285
Uintah	187	55	0	242
Wasatch	56	66	0	122

1139

*Counties in M-X deployment region.

Table 2.1.1-9. Utah NO_x emission inventory by county. (Page 1 of 2)

REGION/COUNTY	STATIONARY SOURCES (TONS/YR)	MOBILE SOURCES (TONS/YR)	NATURAL SOURCES (TONS/YR)	TOTAL (TONS/YR)
AQCR 14 FOUR CORNERS				
Emery	7,370	1,270	11	8,651
Garfield	75	475	11	561
Grand	42	1,296	81	1,419
Iron*	98	1,718	20	1,836
Kane	18	502	26	546
San Juan	105	661	65	831
Washington	79	1,072	12	1,163
Wayne	26	139	2	167
AQCR 220 WASATCH FRONT				
Davis	2,030	6,437	9	8,476
Salt Lake	19,977	18,097	5	38,079
Tooele*	1,308	2,579	48	3,935
Utah	13,169	5,407	11	18,587
Weber	486	5,510	9	6,005
AQCR 219				
Beaver*	24	873	46	943
Box Elder	395	3,348	51	3,794
Cache	159	1,812	6	1,977
Carbon	10,522	1,250	48	11,820
Daggett	17	116	3	136
Duchesne	124	886	6	1,016
Juab*	87	1,284	56	1,427
Millard *	61	1,467	60	1,588

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Table 2.1.1-9. Utah NO_x emission inventory by county. (Page 2 of 2)

REGION/COUNTY	STATIONARY SOURCES (TONS/YR)	MOBILE SOURCES (TONS/YR)	NATURAL SOURCES (TONS/YR)	TOTAL (TONS/YR)
AQCR 219				
(continued)				
Morgan	904	660	1	1,565
Piute	9	209	3	221
Rich	11	161	3	175
Sanpete	77	1,117	19	1,213
Sevier	296	1,461	7	1,764
Summit	252	1,586	22	1,860
Uintah	56	756	48	860
Wasatch	43	925	12	980

1140

*Counties in M-X deployment region.

Table 2.1.1-10. Utah HC emission inventory by county. (Page 1 of 2)

REGION/COUNTY	STATIONARY SOURCES (TONS/YR)	MOBILE SOURCES (TONS/YR)	NATURAL SOURCES (TONS/YR)	TOTAL (TONS/YR)
AQCR 14 FOUR CORNERS				
Emery	250	2,006	65	2,321
Garfield	57	656	64	777
Grand	57	1,362	488	1,907
Iron *	126	1,976	121	2,223
Kane	38	722	154	914
San Juan	276	1,004	391	1,671
Washington	102	1,586	70	1,758
Wayne	166	220	12	398
AQCR 220 WASATCH FRONT				
Davis	914	8,124	54	9,092
Salt Lake	5,009	31,817	28	36,854
Tooele *	168	2,901	290	3,359
Utah	6,146	7,101	65	13,312
Weber	64	7,251	57	7,372
AQCR 219				
Beaver *	46	865	275	1,186
Box Elder	156	4,044	304	4,504
Cache	110	2,446	36	2,592
Carbon	458	1,252	286	1,996
Daggett	6	157	18	181
Duchesne	106	1,862	38	2,006
Juab *	82	1,420	339	1,841
Millard *	1,670	85	359	2,114

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Table 2.1.1-10. Utah HC emission inventory by county. (Page 2 of 2)

REGION/COUNTY	STATIONARY SOURCES (TONS/YR)	MOBILE SOURCES (TONS/YR)	NATURAL SOURCES (TONS/YR)	TOTAL (TONS/YR)
AQCR 219				
(continued)				
Morgan	37	596	9	642
Piute	22	286	16	324
Rich	16	231	18	265
Sanpete	196	1,039	112	1,347
Sevier	206	1,531	39	1,776
Summit	700	1,800	131	2,631
Uintah	160	1,094	287	1,541
Wasatch	13	1,271	70	1,354

1141

*Counties in M-X deployment region.

Table 2.1.1-11. Utah CO emission inventory by county. (Page 1 of 2)

REGION/COUNTY	STATIONARY SOURCES (TONS/YR)	MOBILE SOURCES (TONS/YR)	NATURAL SOURCES (TONS/YR)	TOTAL (TONS/YR)
AQCR 14 FOUR CORNERS				
Emery	829	6,540	379	7,748
Garfield	2,698	3,459	371	6,528
Grand	177	7,003	2,845	10,025
Iron *	554	10,511	704	11,769
Kane	124	3,832	896	4,852
San Juan	1,349	5,007	2,283	8,639
Washington	338	8,710	410	9,458
Wayne	533	1,084	71	1,688
AQCR 220 WASATCH FRONT				
Davis	2,912	44,772	315	47,999
Salt Lake	17,101	187,761	165	205,027
Tooele *	537	15,399	1,691	17,627
Utah	10,979	31,200	378	42,557
Weber	423	44,100	330	44,853
AQCR 219				
Beaver *	174	4,362	1,603	6,139
Box Elder	523	21,246	1,771	23,540
Cache	478	13,270	213	13,961
Carbon	2,244	6,408	1,669	10,321
Daggett	23	843	105	971
Duchesne	328	6,489	220	7,037
Juab *	338	7,390	1,975	9,703
Millard *	338	8,617	2,094	11,049

1142

Table 2.1.1-11. Utah CO emission inventory by county. (Page 2 of 2)

REGION/COUNTY	STATIONARY SOURCES (TONS/YR)	MOBILE SOURCES (TONS/YR)	NATURAL SOURCES (TONS/YR)	TOTAL (TONS/YR)
AQCR 219				
(continued)				
Morgan	144	2,957	50	3,151
Piute	115	1,585	91	1,791
Rich	68	1,264	106	1,438
Sanpete	853	5,313	651	6,817
Sevier	872	7,693	228	8,793
Summit	827	1,356	766	2,949
Uintah	611	5,576	1,674	7,861
Wasatch	52	6,881	410	7,343

1142

*Counties in M-X deployment region.

- natural sources - which include forest fires

Comparison of SO_x emissions for the four counties potentially affected by the M-X system (Iron, Beaver, Juab, and Millard) and other counties in Utah demonstrates that both stationary and mobile emission sources are relatively low. Only Iron County with SO_x pollution from Cedar City which has recently been reduced, had substantial SO_x emissions in 1978. NO_x, CO, and HC emissions are primarily from mobile sources in the four counties with the exception of HC emissions in Millard County, which are primarily from stationary sources.

Gaseous pollutant emission data in the form of a point source emission inventory performed on a subbasin basis are presently being prepared by the State of Nevada.

As a preliminary evaluation of gaseous pollutant baseline levels in Nevada, data from the 1975 NEDS Report have been used to create Tables 2.1.1-12 through 2.1.1-15 for SO_x, NO_x, HC, and CO in Nevada. Only AQCR No. 147 in Nevada has been included in the tables since it contains all the counties within the M-X deployment areas. Source categories have been grouped as stationary, mobile or natural to correspond with Tables 2.1.1-8 through 2.1.1-11.

Figures 2.1.1-5 through 2.1.1-8 are presented for the Nevada/Utah area as a qualitative assessment of the background gaseous pollution levels of SO_x, NO_x, HC, and CO, respectively. Data for these figures were obtained from the 1977 National Air Quality, Monitoring, and Emissions Trends Report.

<u>Ambient Air Quality</u>

Gaseous pollutants with established NAAQS are the photochemical oxidants ozone (O_3), sulfur dioxide (SO_2), non-methane hydrocarbons (NMHC), carbon monoxide (CO), and nitrogen dioxide (NO_2). Gaseous pollutants standards are shown in Table 2.1.1-16.

Nevada and Utah nonattainment areas for gaseous pollutants are shown in Figure 2.1.1-3. Gaseous pollutant nonattainment areas near or within the Nevada/Utah deployment area are: Tooele, Weber, Davis, Salt Lake, and Utah counties, Ogden, Salt Lake City, and Provo in Utah; Steptoe Valley, Reno, Lake Tahoe Basin, and Las Vegas Valley in Nevada.

The Steptoe Valley SO_2 nonattainment status is due to a single emission source, a copper smelter at McGill which operates sporadically. Although the entire Steptoe Valley is designated as nonattainment, the actual area over which the standard is exceeded should be small. The Las Vegas Valley nonattainment status for CO and O_3 is due to a combination of mobile and stationary sources. The SO_2 nonattainment status in Cedar City was caused by the burning of high-sulfur fuel oil at a boiler at the Southern Utah College. High-sulfur oil is no longer burned at the college and ambient air quality violations are no longer recorded.

Figure 2.1.1-9 locates 1977 gaseous pollutant levels as measured in Nevada and Utah. Annual nitrogen dioxide levels measure from less than 10 percent to about 50 percent of the national air quality annual standard. Lowest NO_2 levels are measured in the southwestern Utah area. The eight-hour CO standard is exceeded

Table 2.1.1-12. Nevada SO_x emission inventory by AQCR*.

AQCR	STATIONARY SOURCES (TONS/YR)	MOBILE SOURCES (TONS/YR)	NATURAL SOURCES** (TONS/YR)	TOTAL (TONS/YR)
AQCR 147				
TOTAL	273,650	776	0	274,426
AREA	264	776	0	1,040
POINT	273,386	***	***	273,386

3370

* Data from 1975 National Emission Data System (NEDS) Report

** Forest fires are only emitters applicable to this category

*** Point source designation not applicable to this category

Table 2.1.1-13. Nevada NO_x emission inventory by AQCR*.

AQCR	STATIONARY SOURCES (TONS/YR)	MOBILE SOURCES (TONS/YR)	NATURAL SOURCES** (TONS/YR)	TOTAL (TONS/YR)
AQCR 147				
TOTAL	1,180	11,159	302	12,641
AREA	264	11,159	302	11,725
POINT	916	***	***	916

3371

* Data from 1975 National Emission Data System (NEDS) Report

** Forest fires are only emitters applicable to this category

*** Point sources designation not applicable to this category

Table 2.1.1-14. Nevada HC emission inventory by AQCR*.

AQCR	STATIONARY SOURCES (TONS/YR)	MOBILE SOURCES (TONS/YR)	NATURAL SOURCES** (TONS/YR)	TOTAL (TONS/YR)
AQCR 147				
TOTAL	1,534	12,329	1,810	15,673
AREA	220	12,329	1,810	14,359
POINT	1,314	***	***	1,314

3372

* Data from 1975 National Emission Data System (NEDS) Report

** Forest fires are only emitters applicable to this category

*** Point sources designation not applicable to this category

Table 2.1.1-15. Nevada CO emission inventory by AQCR*.

AQCR	STATIONARY SOURCES (TONS/YR)	MOBILE SOURCES (TONS/YR)	NATURAL SOURCES** (TONS/YR)	TOTAL (TONS/YR)
AQCR 147				
TOTAL	727	68,611	10,558	79,896
AREA	616	68,611	10,558	79,785
POINT	111	***	***	111

3373

* Data from 1975 National Emission Data System (NEDS) Report

** Forest Fires are only emitters applicable to this category

*** Point sources designation not applicable to this category

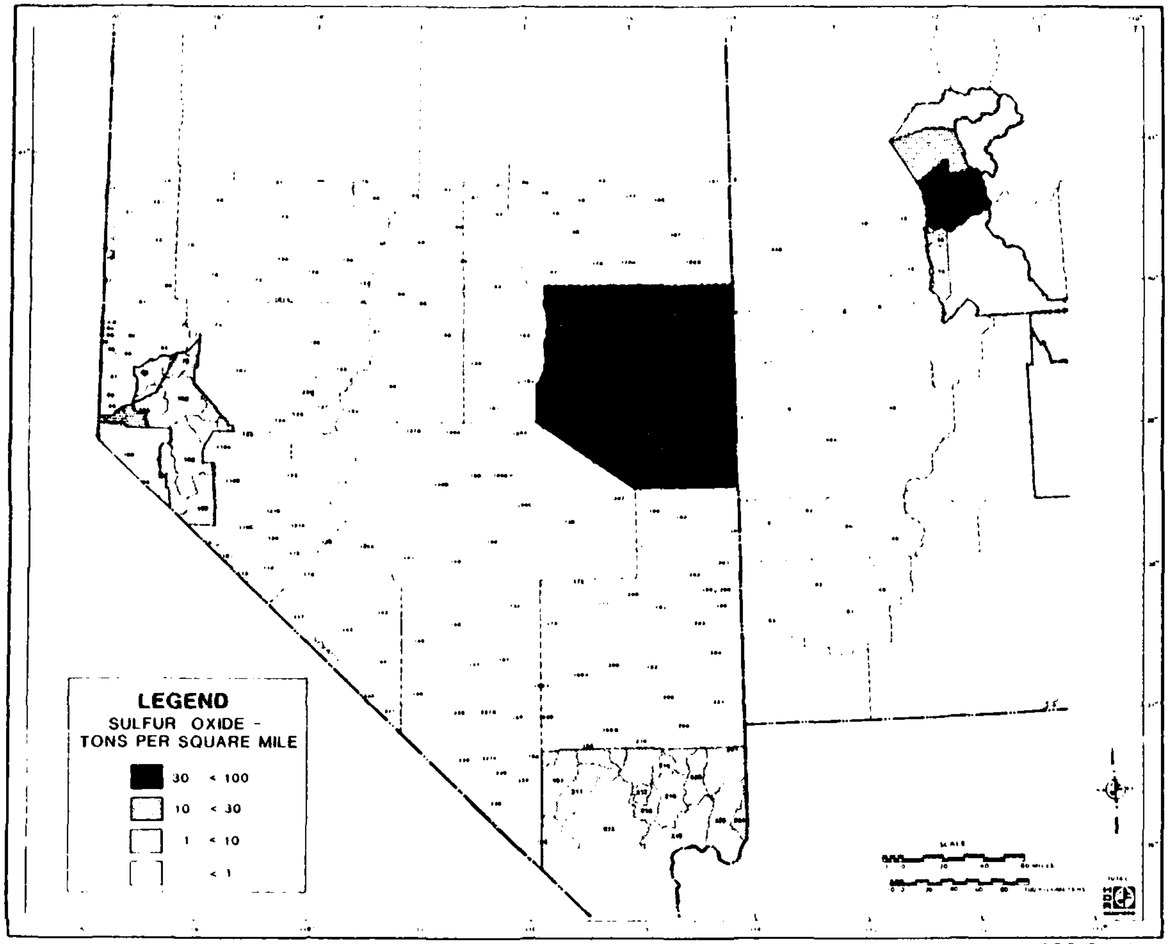

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Figure 2.1.1-5. Sulfur dioxide emission density levels in the Nevada/Utah study area.

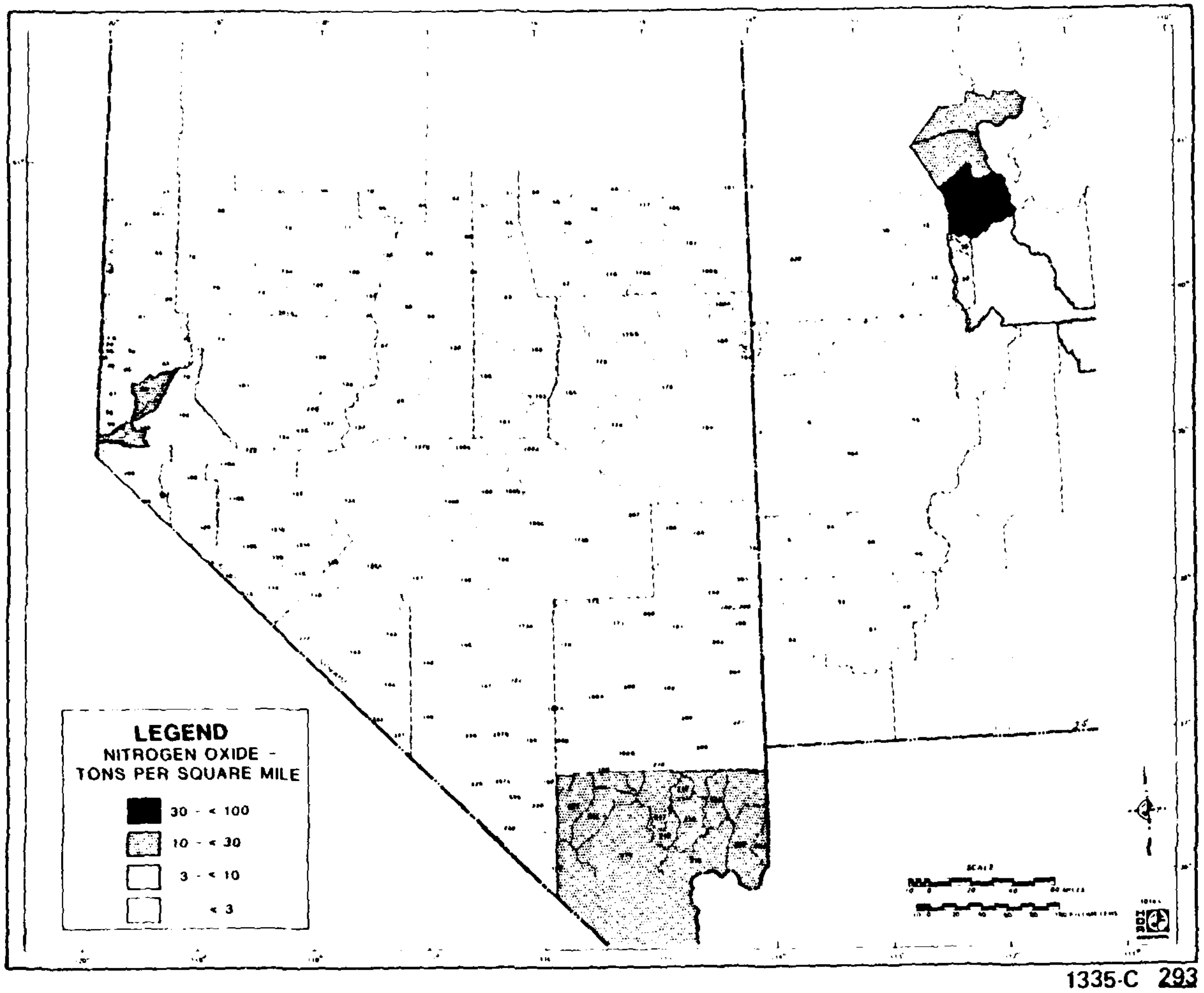

Figure 2.1.1-6. Nitrogen oxide emission density levels in the Nevada/Utah study area.

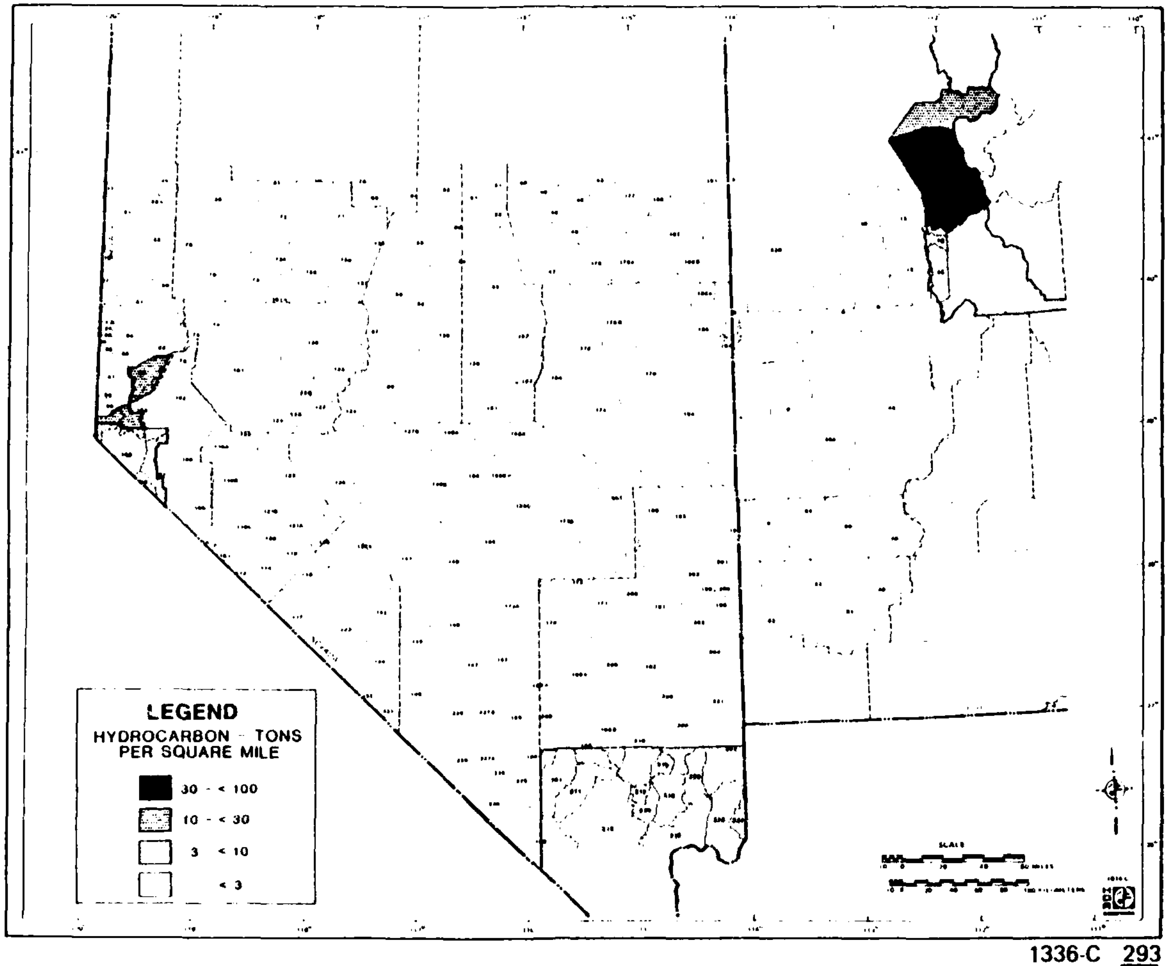

Figure 2.1.1-7. Hydrocarbon emission density levels in the Nevada/Utah study area.

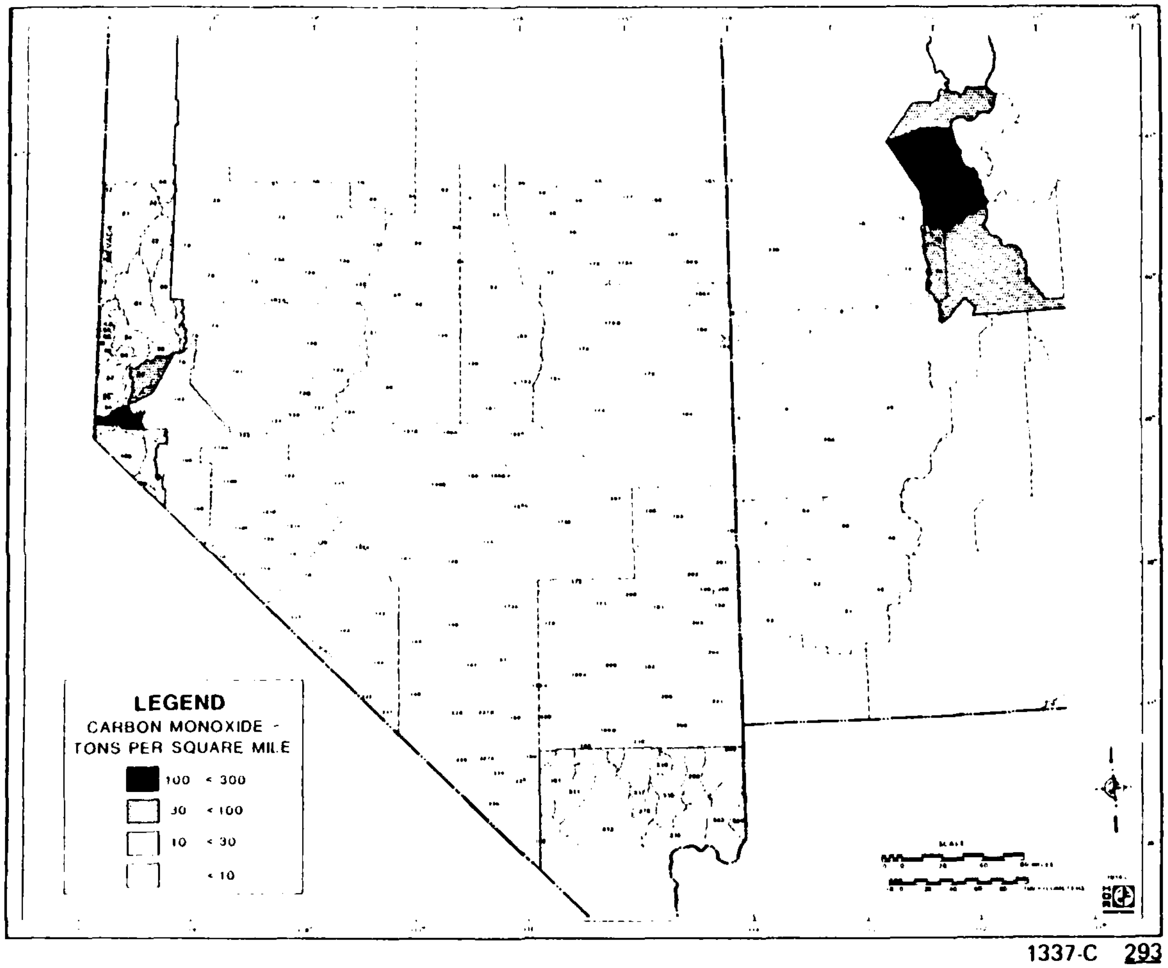

Figure 2.1.1-8. Carbon monoxide emission density levels in the Nevada/Utah study area.

Table 2.1.1-16. Summary of national ambient air quality standards (NAAQS) and Nevada and Utah* ambient air quality standards for gaseous pollutants.

POLLUTANT	AVERAGING TIME	NAAQS AND UTAH STANDARDS		NEVADA STANDARDS
		PRIMARY	SECONDARY	PRIMARY
Carbon Monoxide	8-hour[a]	10 mg/m^3 (9 ppm)	Same as primary standards	Same as NAAQS
	1-hour[a]	40 mg/m^3 (35 ppm)		Same as NAAQS
Carbon Monoxide above 5,000 feet MSL	8-hour[a]	10 mg/m^3 (9 ppm)		6.67 mg/m^3 (6.0 ppm)
	1-hour[a]	40 mg/m^3 (35 ppm)		Same as NAAQS
Ozone	1-hour[b]	235 $\mu g/m^3$ (0.12 ppm)	Same as primary standard	Same as NAAQS
Ozone (Lake Tahoe Basin)	1-hour[b]	n/a		195 $\mu g/m^3$
Nitrogen	Annual (Arithmetic Mean)	100 $\mu g/m^3$ (0.05 ppm)	Same as primary standard	Same as NAAQS
Hydrocarbons (corrected for methane)	3-hour (6-9 a.m.)	160 $\mu g/m^3$ (0.24 ppm)	Same as primary standard	Same as NAAQS
Sulfur Dioxide	Annual (Arithmetic Mean)	80 $\mu g/m^3$ (0.03 ppm)	Same as primary standard	Same as NAAQS
	24-hour[a]	365 $\mu g/m^3$ (0.14 ppm)		Same as NAAQS
	3-hour[a]	None	1,300 $\mu g/m^3$ (0.5 ppm)	1,300 $\mu g/m^3$ (0.5 ppm)

725

*All Utah standards are equivalent to NAAQS.

[a]Not to be exceeded more than once per year.

[b]The ozone standard is attained when the expected number of days per calendar year with a maximum hourly average concentration above the standard is equal to or less than one.

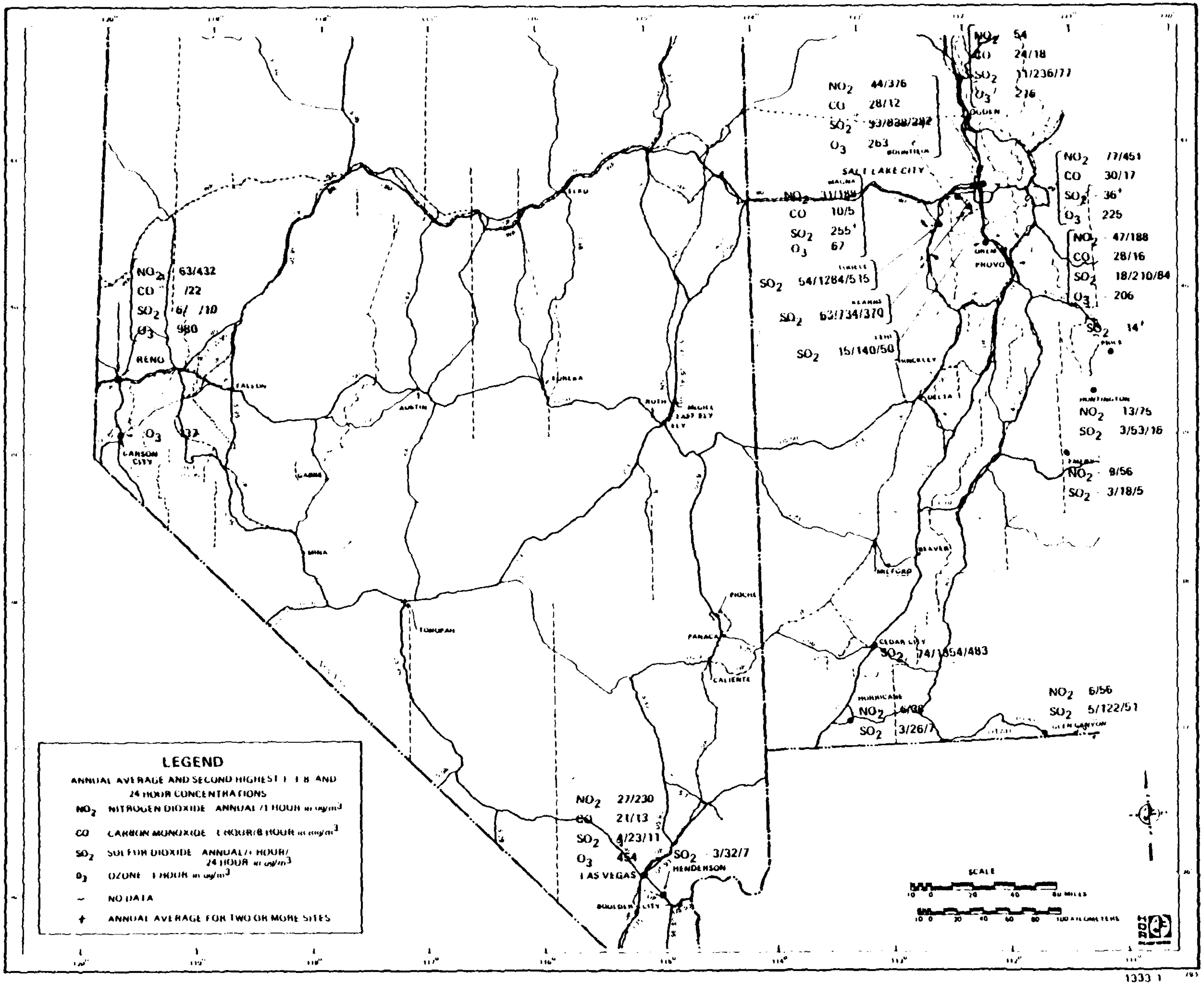

Figure 2.1.1-9. Air quality levels in the Nevada/Utah study area.

at all 7 urban locations measuring CO, except for Magna, Utah where the annual SO_2 standard was exceeded. However, this site measured less than four full quarters of data during 1977. The three-hour SO_2 standard was violated at Cedar City, Utah and was nearly exceeded at Tooele, Utah. Twenty-four-hour SO_2 standard violations were recorded at Cedar City, Tooele, and Kearns, Utah. SO_2 measurements in the Steptoe Valley exceeded SO_2 standards during 1977, as indicated by its nonattainment status. Ozone excesses in 1977 were recorded in Reno and Las Vegas, Nevada, and Bountiful, Utah.

TEXAS/NEW MEXICO (2.1.2)

The Texas/New Mexico basing area is located on the plateau area of eastern New Mexico and the Texas Panhandle often referred to as the High Plains region. This region is semiarid in nature--transitional between desert to the west and humid climates to the east and south. It is essentially a level region with no terrain features affecting wind flow across the plateau. Wind speeds can be extremely high at times. Precipitation is relatively low on the average but can be extremely variable from year to year. The precipitation peak occurs during summer months when the primary source of rain is thunderstorms.

Temperature

Normal maximum temperatures are 50 to 60 degrees F in January and 90 to 100 degrees F in July. Normal minimum temperatures are 20 to 30 degrees F in January and 60 to 70 degrees F in July. The daily temperature range is not quite as great as in Nevada/Utah but still tends to fall in the range of 20 to 30 degrees F throughout the year.

Precipitation

Average annual precipitation levels for the Texas/New Mexico region are displayed in Figure 2.1.2-1. Most areas in this region receive on the average between 12 and 22 in. of precipitation annually. There is a pronounced east-west gradient to the precipitation pattern, with larger amounts falling in the eastern section. This is a result of the closer proximity of this area to the moisture-laden air, transported north from the Gulf of Mexico. The major portion of the precipitation in the Texas/New Mexico region falls during frequent thunderstorms in the summer months. More than 70 percent of the annual precipitation at Amarillo, Texas falls from May to September.

Wind Speeds and Mixing Heights

The dispersive ability of the atmosphere in the Texas/New Mexico basing area is good. The seasonal and annual averaged morning and afternoon mixing heights and wind speeds appear in Table 2.1.2-1. Afternoon mixing heights are large, particularly during the spring through autumn seasons, and wind speeds are brisk. Morning mixing heights are low in comparison. This is a result of nocturnal radiation producing surface-based temperature inversions on a frequent basis. These inversions break up a few hours after sunrise as surface heating by the sun causes vertical mixing in the atmosphere. The prevailing surface wind direction in the Texas/New Mexico region is from the south and southwest.

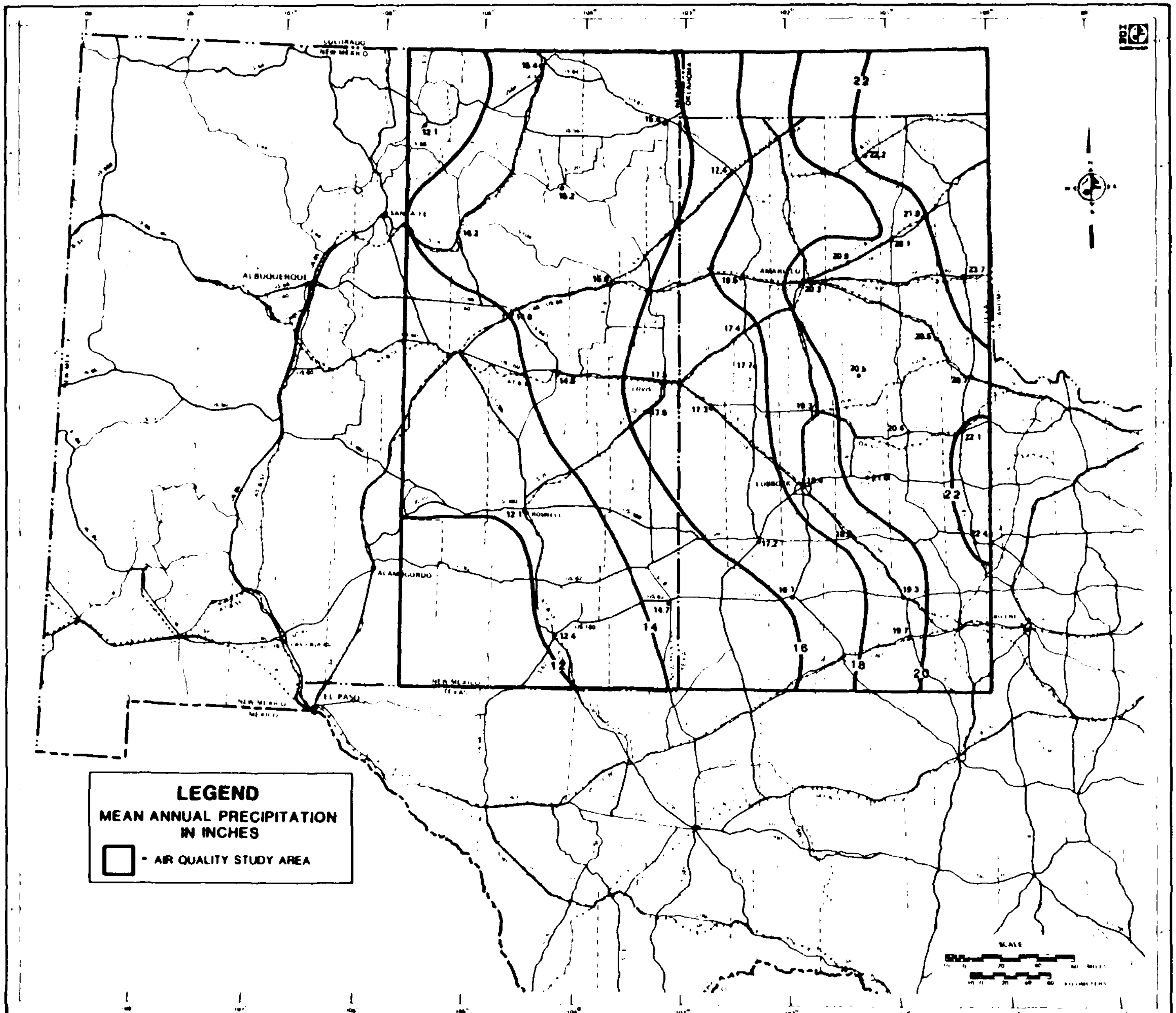

Figure 2.1.2-1. Precipitation in the Texas/New Mexico study area.

Table 2.1.2-1. Wind speeds and mixing heights for stations in Texas/New Mexico.

Station	Time	Winter		Spring		Summer		Autumn		Annual	
		HT[1]	U[2]	HT	U	HT	U	HT	U	HT	U
Albuquerque, NM	Morning	391	4.0	553	4.5	582	3.7	414	3.5	485	4.9
	Afternoon	1,464	5.8	3,452	8.9	3,941	6.0	2,295	5.5	2,788	6.5
Amarillo, TX	Morning	273	6.9	337	8.1	379	7.4	323	6.8	328	7.3
	Afternoon	1,171	8.5	2,507	10.1	2,520	7.4	1,693	7.6	1,973	8.4
Midland, TX	Morning	290	5.7	429	7.5	606	7.2	419	6.0	436	6.6
	Afternoon	1,276	7.8	2,449	9.0	2,744	6.7	1,887	6.7	2,089	7.5

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[1] Mixing height given in meters.

[2] Wind speeds are averaged through the mixed layer and are in units of meters per second.

Source: U.S. Department of Commerce, 1965. "Climatography of the United States, decennial census of the United States climate--climatic summary of the United States--supplement for 1951 through 1960," No. 86-36 (Texas), No. 86-25 (New Mexico), Washington, D.C.

Stability

Atmospheric stability varies seasonally and diurnally in the basing region. The frequency of stability conditions is summarized in Table 2.1.2-2. In the Texas/New Mexico region the atmospheric stability is generally neutral owing to the high wind speeds of the region producing a well-mixed atmosphere. Unstable conditions occur infrequently, but are more frequent in the summer due to the higher solar heating at the surface. Stable conditions occur slightly more frequently in the autumn and winter than in the rest of the year. The occurrence of "episodes" of high pollutant concentrations are often associated with persistent stable conditions which are rare in this region.

Dust Storms

Due to the desert or semiarid nature of most of the land in the basing region, dust is occasionally blown into the atmosphere by wind. At times this natural windblown dust can be of sufficient magnitude to restrict visibility. Table 2.1.2-3 contains data on the frequency of dust observations for the basing region. The Texas Panhandle-eastern New Mexico area is the worst area in the entire United States for windblown dust, experiencing the most frequent dust observations in March and April. This is primarily due to the fact that maximum wind speeds for the year occur during these months. Additionally, the minimum rainfall occurs during the winter and early spring which decreases soil moisture and correspondingly increases the potential for wind erosion.

Baseline Particulate Pollution

Baseline particulate data for the state of New Mexico have been extracted from a 1978 area and point source emission summary which gives source category emissions on a county-by-county basis (see Table 2.1.2-4). Included as source categories are: highway vehicles, off-highway vehicles, and other transportation (mobile sources); process industries, solid waste burning, space heating, and electric power generation (stationary sources); dirt roads and forest fires (fugitive dust sources). Three categories of fugitive dust sources are missing from the New Mexico data. They are dust from construction activity, dust from agricultural activity, and, natural windblown sources.

Data from the 1975 National Emissions Data System (NEDS) Report have been used for a first-step evaluation of baseline particulate emission levels in Texas candidate site areas (see Table 2.1.2-5). AQCR No. 211 contains the counties which are within the possible deployment areas. The source categories have been grouped as either stationary sources or mobile sources. A large gap exists here in that the NEDS report does not include categories that would be considered as fugitive dust sources. Particulate totals reported in an earlier point source inventory for counties in Texas are shown in Table 2.1.2-6.

Assessment of background particulate levels was made from information contained in the 1977 National Air Quality, Monitoring and Emissions Trends Report. Data from this report are presented as TSP emission density maps for the Texas/New Mexico deployment area in Figure 2.1.2-2. Note that the highest annual background emission density to be found in the deployment areas is less than 10

Table 2.1.2-2. Average range of frequency of stability conditions in the Texas/New Mexico region.

Season	Percent Frequency of Stability Conditions		
	Stable	Neutral	Unstable
Winter	25-35	65-75	5-15
Spring	15-25	65-75	5-15
Summer	15-25	45-55	15-25
Autumn	25-35	55-65	5-15
Annual	15-25	55-65	5-15

T831/8-26-81

Source: Doty, S.R., B.L. Wallace and G.C. Holzworth, 1976. "A Climatological Analysis of Pasquill Stability Categories based on 'Star' summaries," U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Climatic Center, Asheville, N.C., April.

Table 2.1.2-3. Monthly percent frequency of dust observations in the Texas/New Mexico regions.

Month	Percent Frequency[1]			
	Clovis	Clayton	Amarillo	Lubbock
January	1.400	2.400	0.700	2.900
February	3.100	0.620	2.100	4.500
March	6.000	3.348	3.400	7.700
April	5.500	1.541	3.200	7.600
May	2.700	0.427	1.100	4.500
June	1.500	0.284	0.700	2.800
July	0.500	0.061	0.300	0.500
August	0.300	0.061	0.100	0.200
September	0.700	0.346	0.400	0.500
October	0.600	0.065	0.400	0.500
November	1.000	0.068	0.600	1.400
December	2.000	0.304	1.300	3.400
Annual Average	2.100	0.610	1.200	3.100

T832/9-18-81/F

[1]The percentage of hourly weather observations in which dust is reported as a restriction to visibility. This occurs when visibility is less than 7 miles and dust is reported in the hourly weather observations.

Source: Orgill and Sehmel, 1975.

Table 2.1.2-4. Baseline anthropogenic particulate emission levels in New Mexico.

REGION/COUNTY	STATIONARY SOURCES TONS/YR	MOBILE SOURCES TONS/YR	FUGITIVE DUST SOURCES TONS/YR	TOTAL TONS/YR	AREA OF COUNTY MI²	DENSITY = TOTAL/AREA TONS/YR/MI²
AQCR 155 Pecos-Permian Basin Intrastate						
Chaves	3,080	378	0	3,458	6,084	[illegible]
Curry	932	578	0	1,510	1,403	1.[illegible]
De Baca	346	42	0	388	2,356	[illegible].16
Eddy	18,639	277	5	18,921	4,167	4.[illegible]4
Lea	1,928	345	2	2,275	4,392	[illegible]
Quay	1,898	185	3	2,086	2,875	[illegible]73
Roosevelt	61	129	9	199	2,454	[illegible]8
AQCR 157 Upper Rio Grande Valley Intrastate						
Taos	9,735	128	10	9,873	2,256	4.38
AQCR 153 Las Cruces-Alamogordo Interstate						
Lincoln	58	105	22	185	4,858	0.04
Otero	4,356	955	30	5,341	6,638	0.80
AQCR 154 Northeastern Plains Interstate						
Colfax	10,355	126	17	10,498	3,764	2.7[illegible]
Guadalupe	74	151	7	232	2,998	0.08
Harding	25	15	5	45	2,134	0.02
Mora	111	46	10	167	1,940	0.0[illegible]
San Miguel	227	157	21	405	4,741	0.09
Torrance	49	143	15	207	3,346	0.06
Union	14	65	2	81	3,816	0.02

3300

Source: 1978 Area and Point Source Emission Summary for State of New Mexico

Table 2.1.2-5. Texas anthropogenic particulate emission inventory by AQCR.[1]

AQCR	STATIONARY SOURCES (TONS/YR)	MOBILE SOURCES (TONS/YR)	FUGITIVE DUST SOURCES (TONS/YR[2]	TOTAL (TONS/YR)
AQCR 211				
Total	46,213	5,710	0	51,923
Area	4,866	5,710	0	10,576
Point	41,347	—[3]	—[3]	41,347

841

[1]Data from 1975 National Emissions Data System (NEDS) Report.

[2]Forest fires are only emitters applicable to this category.

[3]Point source designation not applicable to this category.

Table 2.1.2-6. Baseline point source particulate emission rates in Texas.

COUNTY	PARTICULATE (TONS/YR)
Bailey	1,648
Castro	2,161
Cochran	114
Dallam	710
Deaf Smith	1,729
Hale	2,031
Hartley	358
Hockley	988
Lamb	1,908
Lubbock	1,602
Moore	2,434
Oldham	1,296
Parmer	2,473
Potter	9,838
Randall	170
Sherman	626
Swisher	2,306

3305

Source: 1973 Point Source Inventory for State of Texas.

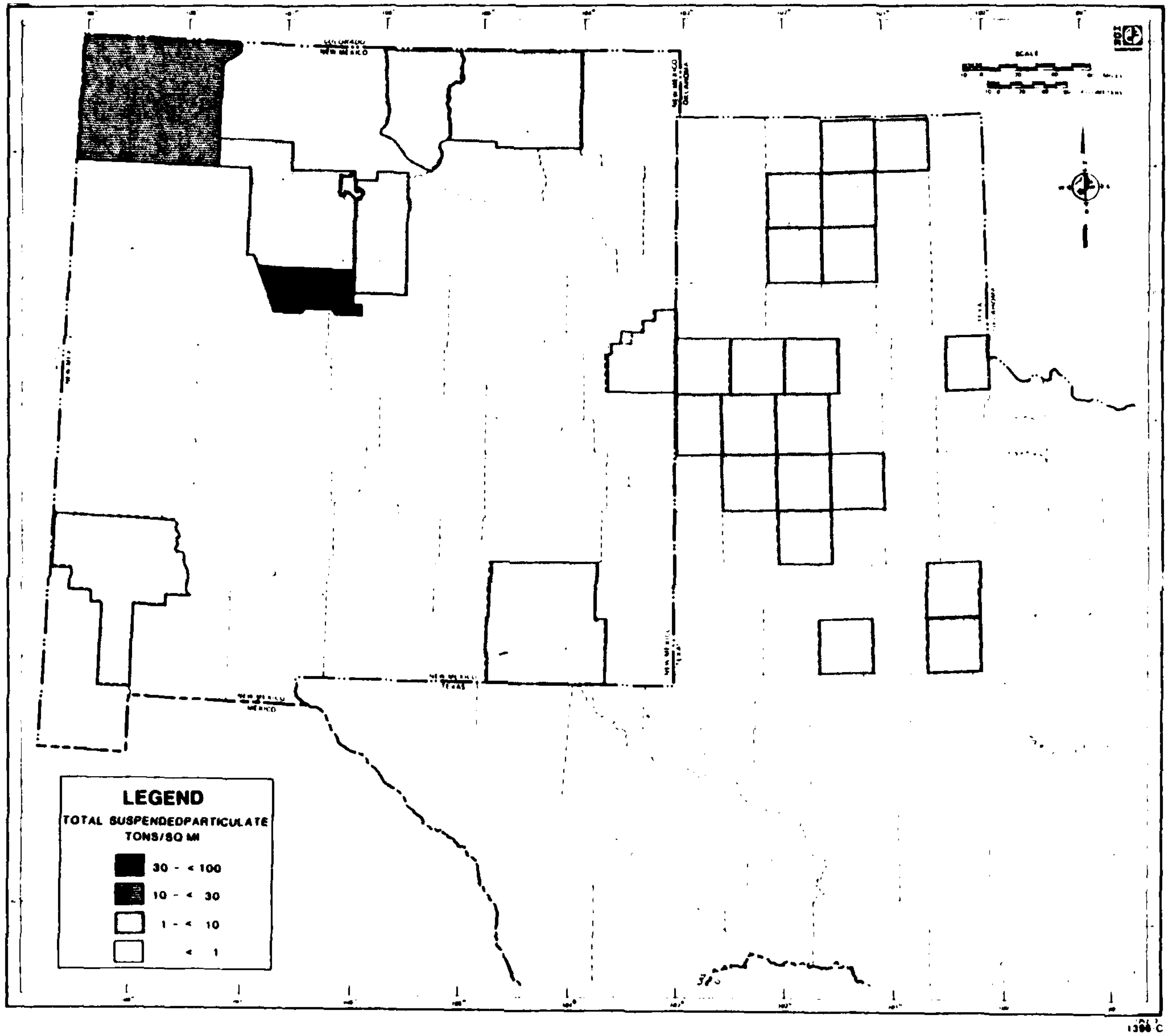

Figure 2.1.2-2. Annual suspended particulate emission densities in the Texas/New Mexico study area.

Table 2.1.2-7. Summary of National Ambient Air Quality Standards (NAAQS) and Texas/New Mexico Ambient Air Quality Standards for particulate matter and lead.

Pollutant	Averaging Time	NAAQS Primary	NAAQS Secondary	Texas Standards	New Mexico Standards
Total Suspended Particulate Matter	Annual (Geometric Mean)	75 ug/m^3	60 ug/m^3 [1]	Same as NAAQS	60 ug/m^3
Total Suspended Particulate Matter	24-hour[2]	260 ug/m^3	150 ug/m^3	150 ug/m^3	150 ug/m^3
Total Suspended Particulate Matter	1-hour[3]	--	--	400 ug/m^3	N/A
Total Suspended Particulate Matter	3-hour[3]	--	--	200 ug/m^3	N/A
Total Suspended Particulate Matter	5-hour[3]	--	--	100 ug/m^3	N/A
Lead	Quarterly (Arithmetic Mean)	1.5 ug/m^3	--	Same as NAAQS	Same as NAAQS

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[1] Secondary annual NAAQS TSP standard (60 ug/m^3) is a guide for assessing state implementation plans.

[2] Not to be exceeded more than once per year.

[3] Not to be exceeded any time by any single major stationary source or group of sources located on contiguous property.

tons/sq mi (3.5 tonnes/sq km). These levels do not include values of particulate emission from fugitive dust sources.

Air Quality Levels

NAAQS and state standards for TSP and lead applicable in the Texas/New Mexico area are shown in Table 2.1.2-7. In addition to the NAAQS, Texas has implemented more strict short-term particulate standards that apply to a single source or group of contiguously located sources. New Mexico has adopted the stricter NAAQS secondary standard as their primary standard. No lead standard other than the NAAQS has been adopted in New Mexico or Texas.

Nonattainment areas in the Texas and New Mexico deployment area are shown in Figure 2.1.2-3. The area that is pertinent to the study of air quality effects in the deployment area is shown by the inner border. TSP nonattainment areas in Lea and Eddy Counties are the only nonattainment areas in the deployment area.

Mandatory Class I areas and current Class II areas recommended for consideration for redesignation to Class I status in the Texas/New Mexico study are also given in Figure 2.1.2-3. Mandatory Class I areas in Texas and New Mexico include Carlsbad Caverns, White Mountain wilderness area, Salt Creek wilderness area, Wheeler Peak wilderness area and Pecos wilderness area. These mandatory Class I areas have air quality regulatory restrictions concerning air quality TSP increments that cannot be exceeded (see Table 2.1.1-7). The Capulin Mountain National Monument has been recommended for consideration for redesignation to Class I status. The remaining area within the study area in attainment of NAAQS is designated as Class II. Class II increments for TSP are 19 $\mu g/m^3$ and 37 $\mu g/m^3$ for annual and 24-hour periods, respectively.

TSP ambient air quality levels levels in the Texas High Plains air quality study area are shown in Figure 2.1.2-4. Annual and 24-hour average TSP levels are greater than 50 percent of the primary NAAQS at all sites.

Baseline Gaseous Pollutants

Sources (Emissions)

Baseline gaseous pollutant levels for each of the deployment areas within the states of Texas and New Mexico are necessary in order to accurately assess the emission impact created by construction and deployment of the M-X system. The Texas/New Mexico region is open terrain over which pollutant dispersal may cover large areas.

Baseline data on gaseous pollutants for the State of New Mexico were extracted from a 1978 area and point source emissions summary which gives source category emissions on a county-by-county basis (see Tables 2.1.2-8 through 2.1.2-11). The source categories listed in the tables are:

- o mobile sources - which include highway vehicles, off-highway vehicles, and other transportation

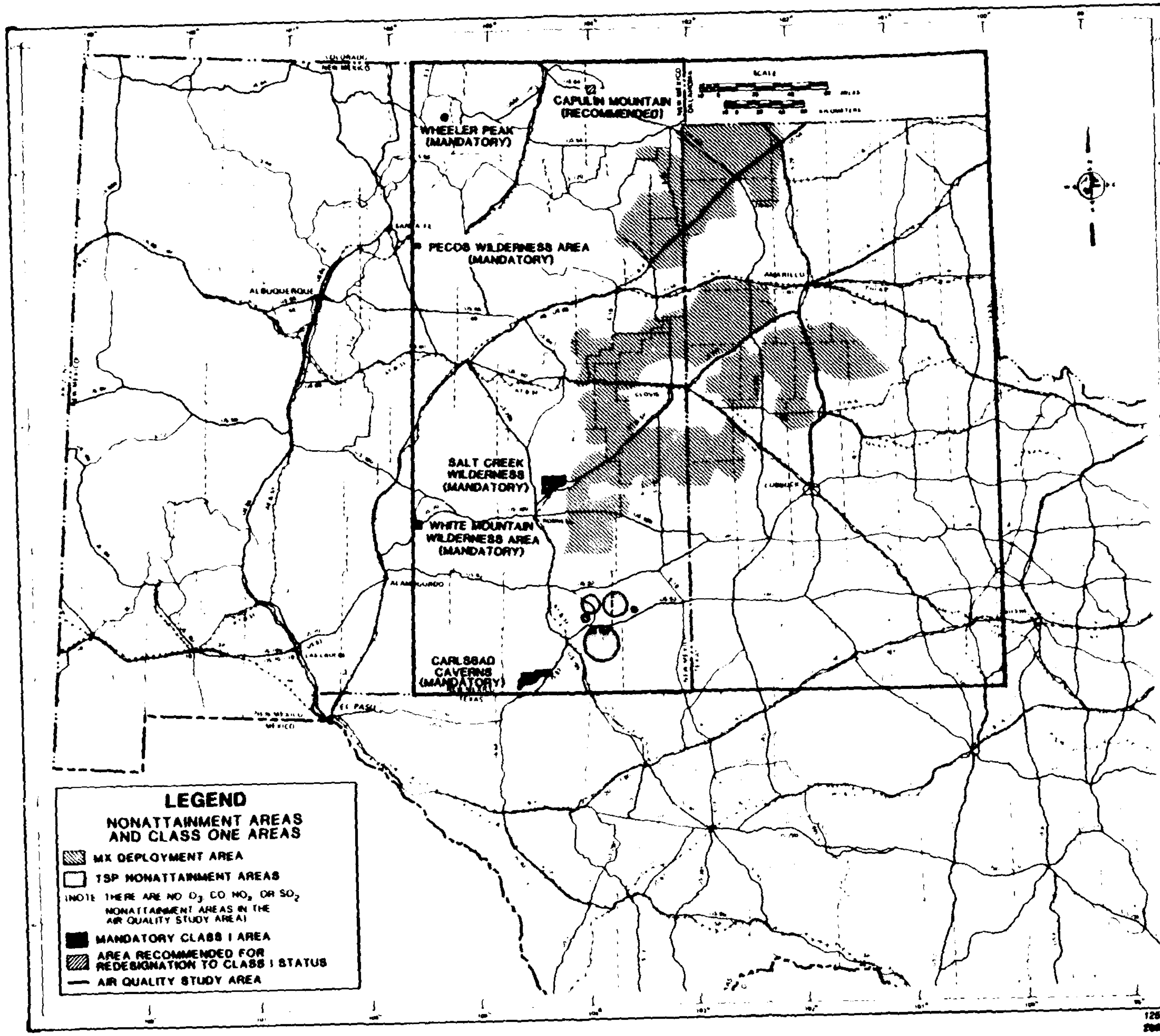


Figure 2.1.2-3. Class I areas and nonattainment areas in the Texas/New Mexico study area.

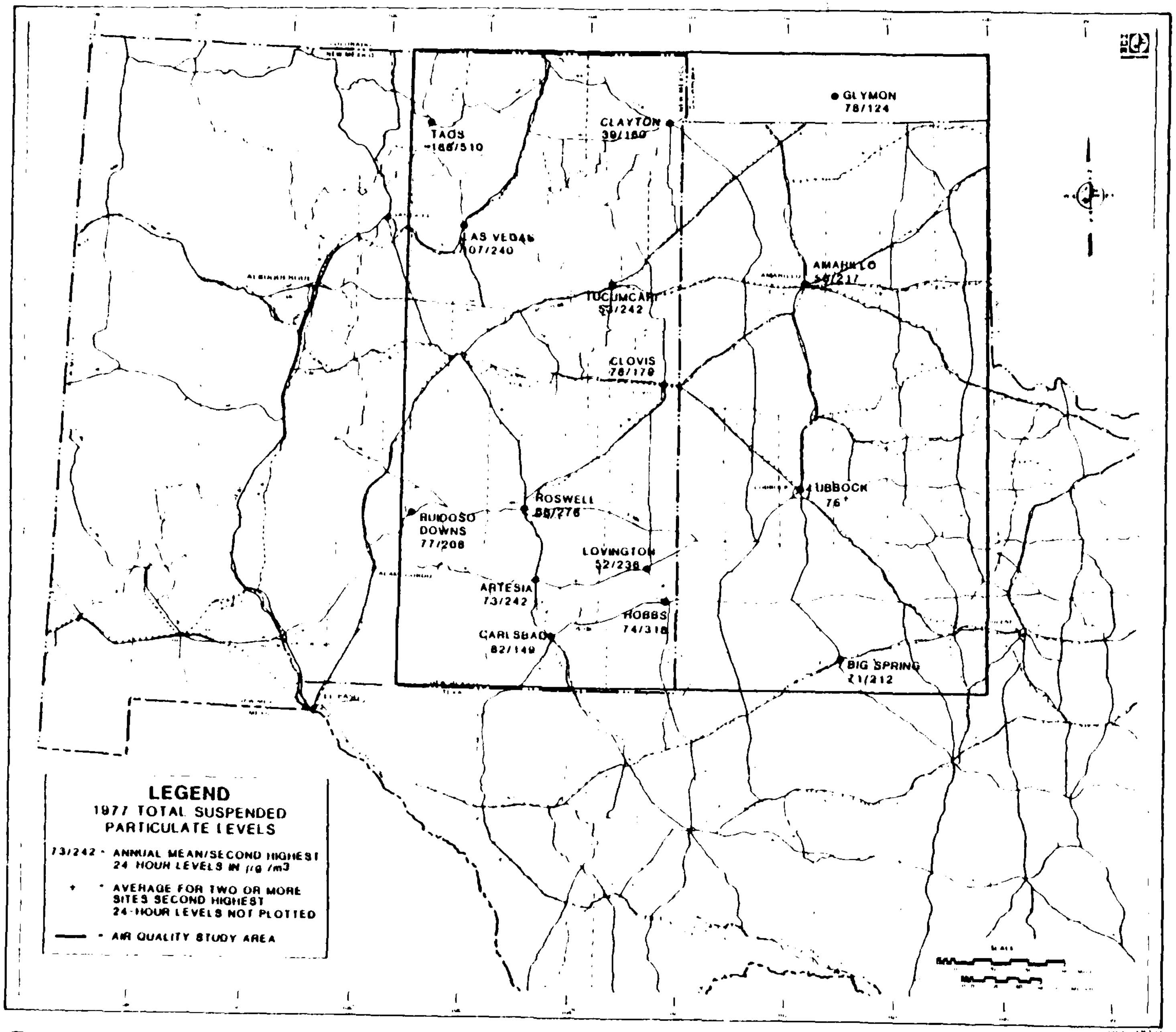


Figure 2.1.2-4. Total suspended particulate concentrations in the Texas/New Mexico study area.

Table 2.1.2-8. Baseline SO_x emission levels in New Mexico.

REGION COUNTY	STATIONARY SOURCES TONS/YR	MOBILE SOURCES TONS/YR	NATURAL SOURCES TONS/YR	TOTAL TONS/YR	AREA OF COUNTY MI^2	DENSITY = TOTAL/AREA TONS/YR MI^2
AQCR 155						
Pecos-Permian						
Basin Intrastate						
Chaves	339	238	0	577	6,084	.09
Curry	301	263	0	564	1,403	.40
De Baca	7	19	0	26	2,356	.01
Eddy	27,106	201	0	27,307	4,167	6.55
Lea	108,605	241	0	108,846	4,392	24.78
Quay	23	88	0	111	2,875	.04
Roosevelt	1,526	90	0	1,616	2,454	.66
AQCR 157						
Upper Rio Grande						
Valley Intrastate						
Taos	71	90	0	161	2,256	.07
AQCR 153						
Las Cruces-						
Alamogordo						
Intrastate						
Lincoln	16	54	0	70	4,858	.01
Otero	189	328	0	517	6,638	.08
AQCR 154						
Northeastern						
Plains Interstate						
Colfax	176	74	0	250	3,764	.07
Guadalupe	15	54	0	69	2,998	.02
Harding	5	9	0	14	2,134	.01
Mora	54	27	0	81	1,941	.04
San Miguel	53	103	0	156	4,741	.03
Torrance	10	58	0	68	3,346	.02
Union	14	36	0	50	3,816	.01

3371

Source: 1978 Area and Point Source Emission Summary for State of New Mexico.

Table 2.1.2-9. Baseline NO_x emission levels in New Mexico.

REGION COUNTY	STATIONARY SOURCES TONS/YR	MOBILE SOURCES TONS/YR	NATURAL SOURCES TONS/YR	TOTAL TONS/YR	AREA OF COUNTY MI^2	DENSITY = TOTAL/AREA TONS/YR/MI^2
AQCR 155						
Pecos-Permian						
Basin Intrastate						
Chaves	687	3,125		[illegible]	6,084	[illegible]
Curry	244	2,749	[illegible]	[illegible]	1,4[illegible]3	[illegible].14
De Baca	12	418	[illegible]	431	2,356	[illegible]
Eddy	[illegible]	2,771	1	[illegible]	4,167	1.41
Lea	7,664	3,447	1	11,112	4,342	[illegible]
Quay	1,521	1,755	1	3,277	2,875	1.14
Roosevelt	2[illegible]4	1,311	1	1,515	2,454	.62
AQCR 157						
Upper Rio Grande						
Valley Intrastate						
Taos	[illegible]	1,327	2	2,375	2,256	[illegible]
AQCR 153						
Las Cruces-						
Alamogordo						
Interstate						
Lincoln	157	1,003	5	1,165	4,858	.24
Otero	208	3,133	7	3,348	6,638	[illegible]
AQCR 154						
Northeastern						
Plains Interstate						
Colfax	2[illegible]2	1,252	4	1,4[illegible]8	3,764	.3[illegible]
Guadalupe	4	1,432	2	1,474	2,998	.4[illegible]
Harding	1[illegible]	156	1	17[illegible]	2,134	.0[illegible]
Mora	13[illegible]	474	1	611	1,[illegible]4	.3[illegible]
San Miguel	1[illegible]	1,586	[illegible]	1,786	4,741	.38
Torrance	[illegible]	1,34[illegible]	4	1,[illegible]	3,346	.41
Union	[illegible]	[illegible]4[illegible]	1	1,4[illegible]1	3,816	.3[illegible]

33 1

Source: 197[illegible] Area and Point Source Emission Summary for State of New Mexico.

Table 2.1.2-10. Baseline CO emission levels in New Mexico.

REGION/COUNTY	STATIONARY SOURCES TONS/YR	MOBILE SOURCES TONS/YR	NATURAL SOURCES TONS/YR	TOTAL TONS/YR	AREA OF COUNTY MI^2	DENSITY = TOTAL/AREA TONS/YR/MI^2
ACQR 155 Pecos-Permian Basin Intrastate						
Chaves	553	19,413	0	19,964	6,084	3.28
Curry	465	15,867	0	16,332	1,403	11.64
De Baca	42	2,651	0	2,693	2,356	1.14
Eddy	5,384	16,214	39	21,637	4,617	5.19
Lea	931	20,092	20	21,043	4,392	4.79
Quay	140	11,285	27	11,452	2,875	3.98
Roosevelt	194	7,079	47	7,320	2,454	2.98
ACQR 157 Upper Rio Grande Valley Intrastate						
Taos	1,694	6,385	84	8,163	2,256	3.62
ACQR 153 Las Cruces-Alamogordo Interstate						
Lincoln	117	6,327	181	6,625	4,858	1.36
Otero	2,291	16,843	246	19,380	6,638	2.92
ACQR 154 Northeastern Plains Interstate						
Colfax	1,186	7,316	140	8,644	3,764	2.30
Guadalupe	335	9,094	56	9,485	2,998	3.16
Harding	85	811	40	936	2,134	.44
Mora	116	2,300	26	2,442	1,940	1.26
San Miguel	1,334	9,224	176	10,734	4,741	2.26
Torrance	86	8,351	125	8,562	3,346	2.56
Union	50	3,577	18	3,645	3,816	.96

Source: 1979 Area and Point Source Emission Summary for State of New Mexico.

Table 2.1.2-11. Baseline HC emission levels in New Mexico.

REGION/COUNTY	STATIONARY SOURCES TONS/YR	MOBILE SOURCES TONS/YR	NATURAL SOURCES TONS/YR	TOTAL TONS/YR	AREA OF COUNTY MI^2	DENSITY = TOTAL/AREA $TONS/YR/MI^2$
ACQR 115						
Pecos-Permian						
Basin Intrastate						
Chaves	2,183	3,099	0	5,282	6,084	.87
Curry	878	3,016	0	3,894	1,403	2.78
De Baca	62	497	0	559	2,356	.24
Eddy	4,751	2,567	7	7,325	4,167	1.76
Lea	16,288	3,188	3	19,479	4,392	4.44
Quay	484	1,929	5	2,418	2,875	.84
Roosevelt	704	1,214	7	1,925	2,454	.78
ACQR 157						
Upper Rio Grande						
Valley Intrastate						
Taos	1,096	1,112	14	2,222	2,256	.98
ACQR 153						
Las Cruces-						
Alamogordo						
Interstate						
Lincoln	1,083	1,071	31	2,185	4,858	.45
Otero	1,215	4,042	42	5,299	6,638	.80
ACQR 154						
Northeastern						
Plains Interstate						
Colfax	39	1,253	24	1,676	3,764	.45
Guadalupe	205	1,675	10	1,890	2,998	.63
Harding	71	151	7	229	2,134	.11
Mora	112	468	3	583	1,940	.30
San Miguel	613	1,581	30	2,224	4,741	.47
Torrance	[illegible]	1,54[illegible]	21	2,169	3,346	.65
Union	207	631	3	841	3,816	.22

3304

Source: 1978 Area and Point Source Emission Summary for State of New Mexico.

- o stationary sources - which include process industries, solid waste burning, space heating, and electric power generation

- o natural sources - which include forest fires

Gaseous pollutant baseline emission levels in Texas were obtained from the 1975 NEDS Report and used to create Tables 2.1.2-12 through 2.1.2-15 for SO_x, NO_x, HC, and CO. Only AQCR No. 211 has been included in the tables since it contains the counties within the possible M-X deployment areas. Source categories have been grouped as stationary, mobile, or natural sources to correspond with Tables 2.1.2-8 through 2.1.2-11. Totals reported in the point-source inventory for counties in the Texas deployment area are given in Table 2.1.2-16.

Figures 2.1.2-5 through 2.1.2-8 show the distribution of emissions levels of SO_x, NO_x, HC, and CO for the Texas/New Mexico area. Data for these figures were obtained from information in the 1977 EPA National Air Quality, Monitoring, and Emissions Trends Report.

Ambient Air Quality Levels

National gaseous pollutant standards and state standards applicable in Texas and New Mexico are given in Table 2.1.2-17. Texas has not adopted any standards that are stricter than the NAAQS. New Mexico has gaseous pollutant standards that are stricter than the NAAQS for carbon monoxide, ozone, and sulfur dioxide.

There are no nonattainment areas for gaseous pollutants in the study area. (See Figure 2.1.2-3). The Class I areas in the study region were previously described and are shown in Figure 2.1.2-3. The rest of the study area has Class II status. The air pollutant increments for sulfur dioxide in Class I and Class II areas are given in Table 1-1. Class I and II increments for other gaseous pollutants are expected to be adopted by the EPA in the near future.

Figure 2.1.2-9 shows locations of gaseous pollutant levels measured in the New Mexico and Texas High Plains study region. Annual SO_2 values in the region are far below the annual standard. NO_2 values are approximately one-fourth of the annual standard. CO levels at Roswell, New Mexico, the only CO monitor in the region, are below the one- and eight-hour CO standards.

Point Source Emissions

There are numerous point sources of emissions in Texas and New Mexico within 30 mi of the M-X deployment area. The predominant types of sources include grain elevators, feed lots, and petroleum industries. The vast majority of point source emissions in this area consist of particulate emissions.

Visibility

Federal Land Managers have defined the nature of visibility impairment in Class I areas as well as the potential sources of this impairment. This is summarized for regions corresponding to the Texas/New Mexico siting area in Table 2.1.2-18. Visibility restrictions in the Texas/New Mexico region are mainly related to agricultural activities, natural haze, and windblown dust. Both Texas and

Table 2.1.1-12. Texas SO_x emission inventory by AQCR*.

AQCR	STATIONARY SOURCES (TONS/YR)	MOBILE SOURCES (TONS/YR)	NATURAL SOURCES** (TONS/YR)	TOTAL (TONS/YR)
AQCR 211				
TOTAL	71,624	3,304	0	74,928
AREA	4,603	3,304	0	7,907
POINT	67,021	***	***	67,021

3374

* Data from 1975 National Emission Data System (NEDS) Report

** Forest fires are only emitters applicable to this category

*** Point source designation not applicable to this category

Table 2.1.2-13. Texas NO_X emission inventory by AQCR*.

AQCR	STATIONARY SOURCES (TONS/YR)	MOBILE SOURCES (TONS/YR)	NATURAL SOURCES** (TONS/YR)	TOTAL (TONS/YR)
AQCR 211				
TOTAL	88,891	51,432	0	140,323
AREA	3,051	51,432	0	54,483
POINT	85,840	***	***	85,840

3375

* Data from 1975 National Emission Data System (NEDS) Report

** Forest fires are only emitters applicable to this category

*** Point sources designation not applicable to this category

Table 2.1.2-14. Texas HC emission inventory by AQCR*.

AQCR	STATIONARY SOURCES (TONS/YR)	MOBILE SOURCES (TONS/YR)	NATURAL SOURCES** (TONS/YR)	TOTAL (TONS/YR)
AQCR 211				
TOTAL	96,710	55,326	0	156,036
AREA	1,570	55,326	0	56,896
POINT	95,140	***	***	95,140

3376

* Data from 1975 National Emission Data System (NEDS) Report

** Forest fires are only emitters applicable to this category

*** Point sources designation not applicable to this category

Table 2.1.2-15. Texas CO emission inventory by AQCR*.

AQCR	STATIONARY SOURCES (TONS/YR)	MOBILE SOURCES (TONS/YR)	NATURAL SOURCES** (TONS/YR)	TOTAL (TONS/YR)
AQCR 211				
TOTAL	799,495	300,648	0	1,100,143
AREA	4,335	300,648	0	304,983
POINT	795,160	***	***	795,160

3377

* Data from 1975 National Emission Data System (NEDS) Report

** Forest fires are only emitters applicable to this category

*** Point sources designation not applicable to this category

Table 2.1.2-16. Baseline point source gaseous emission levels in Texas.

COUNTY	NO_x (TONS/YR)	SO_2 (TONS/YR)	HC (TONS/YR)	CO (TONS/YR)
Bailey	—	—	9	27
Castro	691	—	1,316	1
Cochran	490	605	52	1
Dallam	—	—	—	—
Deaf Smith	279	35	59	174
Hale	3,651	3,022	2,573	26
Hartley	—	—	—	—
Hockley	4,538	2,581	475	3
Lamb	3,087	92	24	54
Lubbock	3,874	32	879	93
Moore	25,349	5,517	16,204	102,626
Oldham	—	—	—	—
Parmer	51	—	5	35
Potter	7,997	57,968	8,556	20,554
Randall	—	—	—	—
Sherman	—	—	—	—
Swisher	2	—	63	—

3306

Source: 1971 Point Source Inventory for State of Texas.

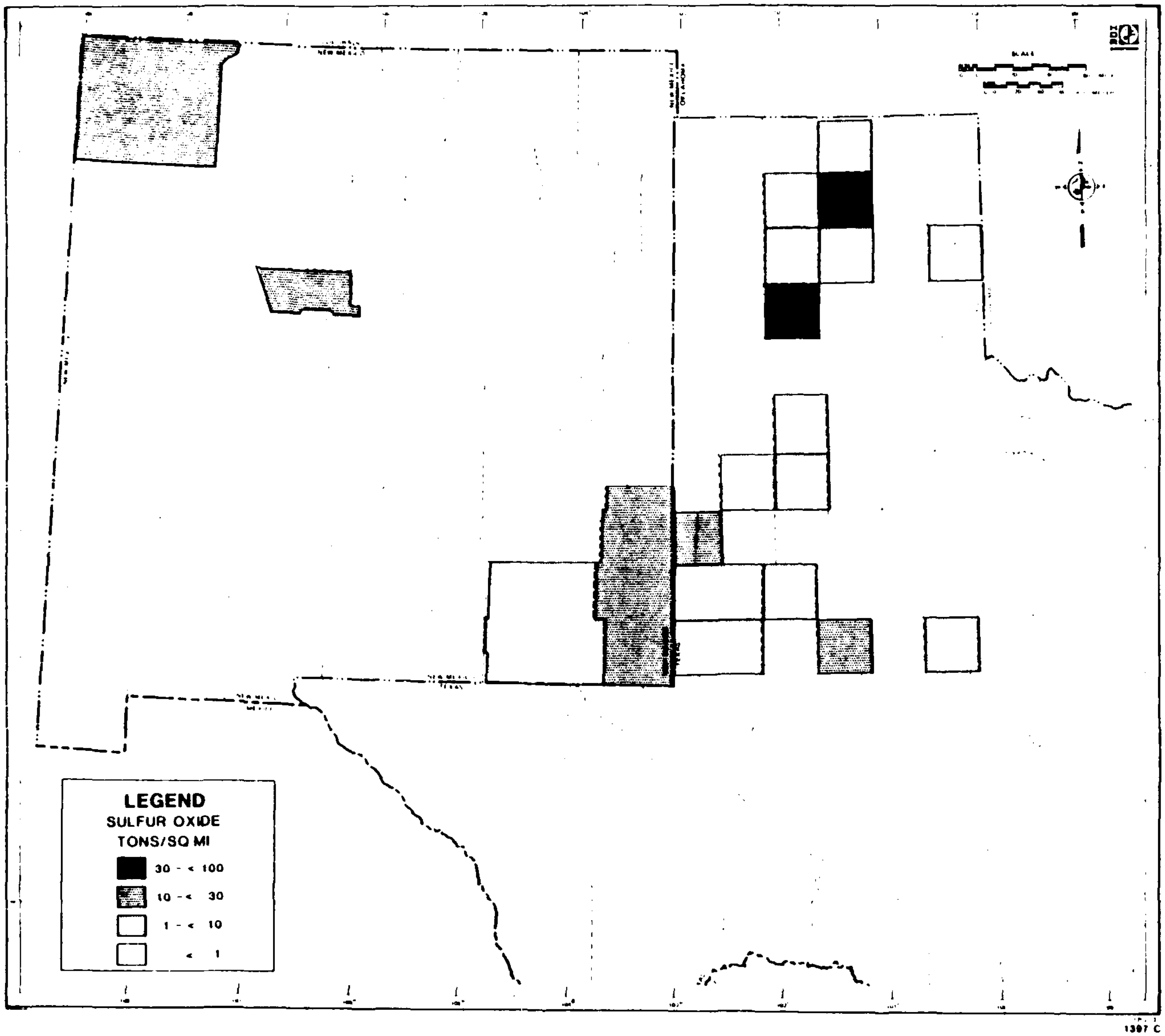


Figure 2.1.2-5. Sulfur oxide annual emission densities in the Texas/ New Mexico study area and vicinity.

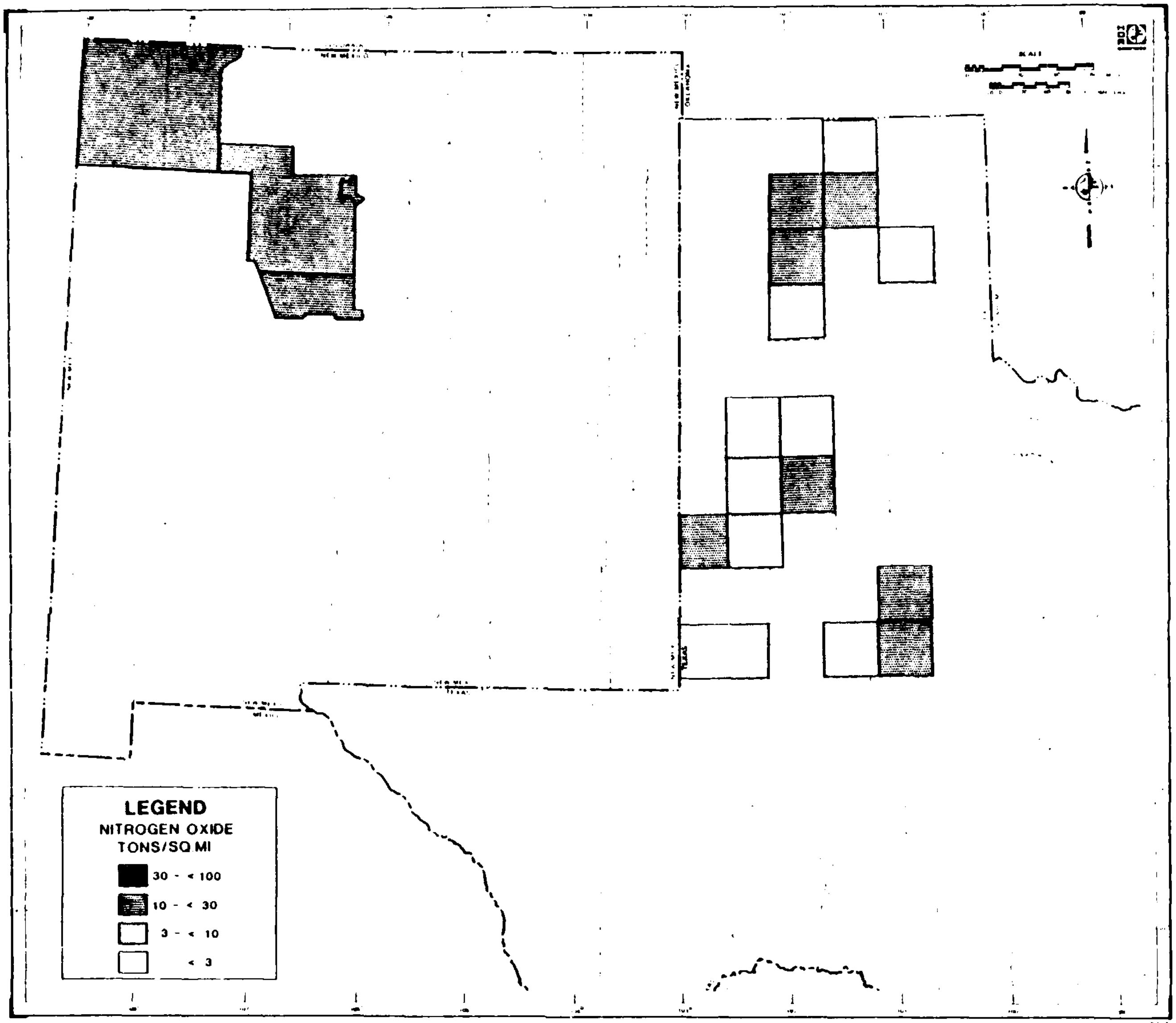


Figure 2.1.2-6. Nitrogen oxide annual emission densities in the Texas/New Mexico study area and vicinity.

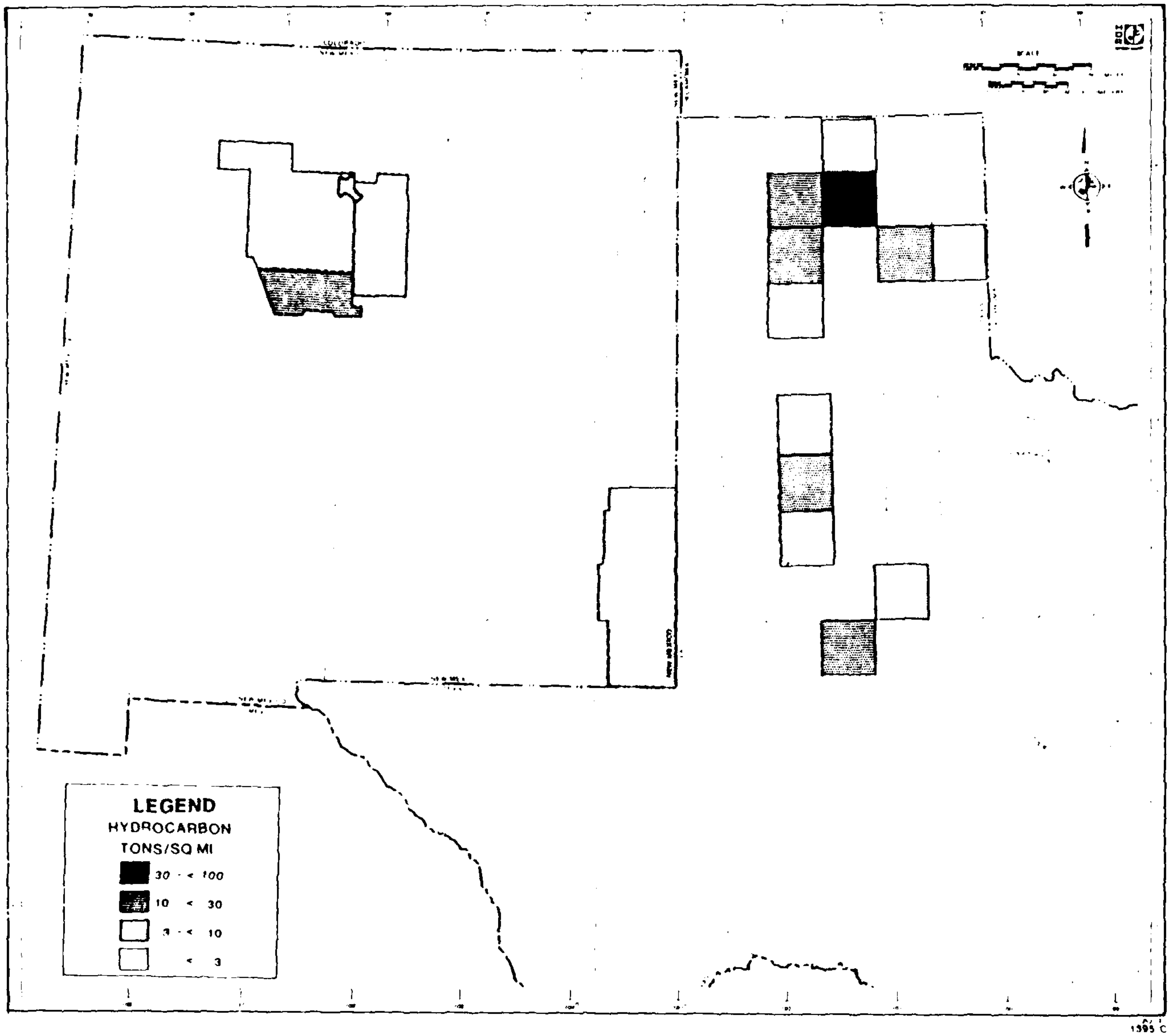


Figure 2.1.2-7. Hydrocarbon annual emission densities in the Texas/New Mexico study area and vicinity.

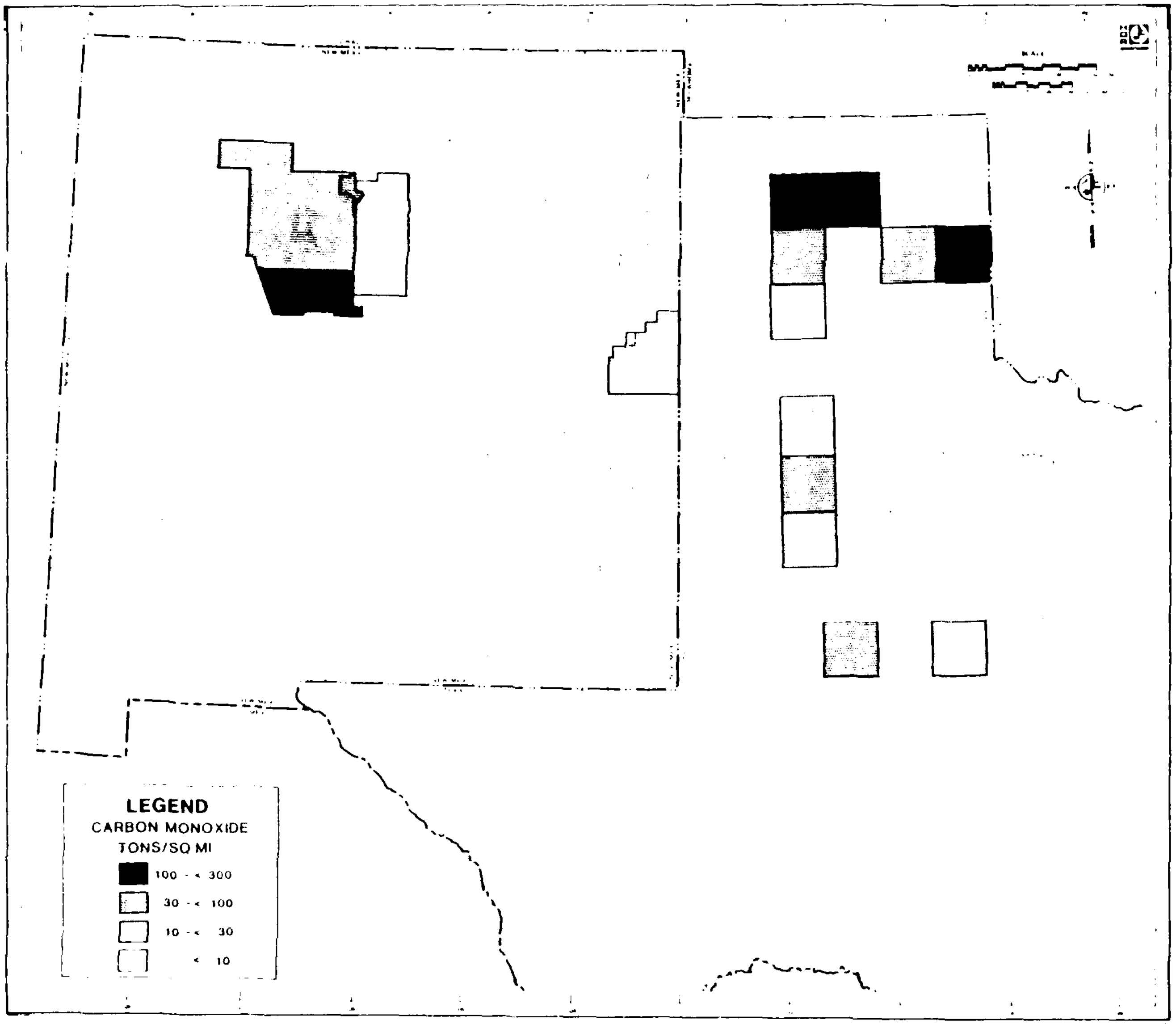


Figure 2.1.2-8. Carbon monoxide annual emission densities in the Texas/New Mexico study area and vicinity.

Table 2.1.2-17. Summary of National Ambient Air Quality Standards (NAAQS) and Texas and New Mexico ambient air quality standards for gaseous pollutants.

Pollutant	Averaging Time	NAAQS Primary	NAAQS Secondary	Texas Standards	New Mexico Standards
Carbon Monoxide	8-hour[1]	10 mg/m^3 (9 ppm)	Same as primary standard	Same as NAAQS	9.7 mg/m^3 (8.7 ppm)
	1-hour[1]	40 mg/m^3 (35 ppm)			15 mg/m^3 (13.1 ppm)
Carbon Monoxide above 5,000 ft MSL	8-hour[1]	10 mg/m^3 (9 ppm)	Same as primary standard	Same as NAAQS	Same as NAAQS
	1-hour[1]	40 mg/m^3 (35 ppm)			
Ozone	1-hour[2]	235 ug/m^3 (0.12 ppm)	Same as primary standard	Same as NAAQS	118 ug/m^3 (0.06 ppm)
Nitrogen Dioxide	Annual (Arithmetic Mean)	100 ug/m^3 (0.05 ppm)	Same as primary standard	Same as NAAQS	Same as NAAQS
Hydrocarbons (Corrected for Methane)	3-hour (6-9 a.m.)	160 ug/m^3 (0.24 ppm)	Same as primary standard	Same as NAAQS	127 g/m^3 (0.19 ppm)
Sulfur Dioxide	Annual (Arithmetic Mean)	80 ug/m^3 (0.03 ppm	Same as primary standard	Same as NAAQS	52 ug/m^3 (0.02 ppm)
	24-hour[1]	365 ug/m^3 (0.14 ppm)			260 ug/m^3 (0.10 ppm)
	3-hour[1]	none	1,300 ug/m^3	Same as NAAQS	Same (0.5 ppm)NAAQS

T1376/9-18-81/F

[1]Not to be exceeded more than once per year.

[2]The ozone standard is attained when the expected number of days per calendar year with a maximum hourly average concentration above the standard is equal to or less than one.

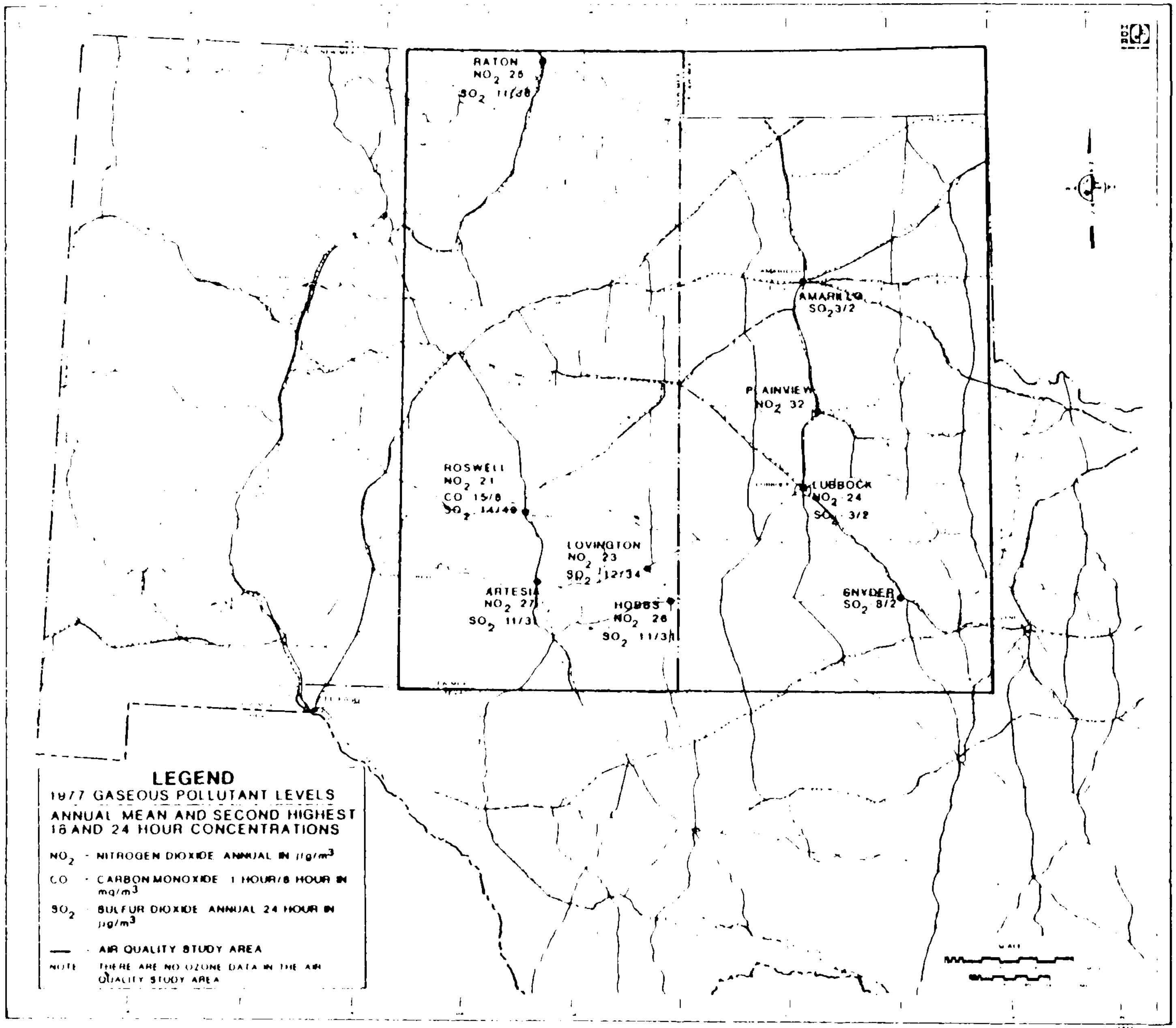


Figure 2.1.2-9. Gaseous pollutant levels in the Texas/New Mexico study area.

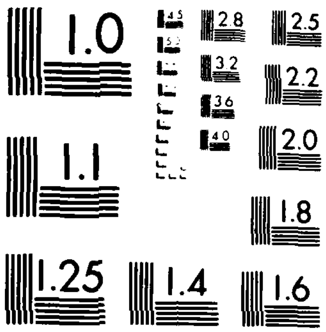
Table 2.1.2-18. Nature of PSD Class I area visibility impairment in M-X siting region.

REGION	REPORTED VISIBILITY STATUS	OBSERVED VISIBILITY PHENOMENA	POTENTIAL SOURCES		POTENTIAL FUTURE IMPAIRMENT
			MAN MADE	NATURAL	
Eastern New Mexico-Western Texas	Generally desirable visibility; Need to assess noted	1. Haze 2. Dust 3. Smoke	1. Smelters 2. Agricultural Activities 3. Prescribed Burning	1. Natural Haze 2. Windblown Dust	Possible decrease in smelter impacts. Increased general development.

745-2

AD-A149 903 DEPLOYMENT AREA SELECTION AND LAND WITHDRAWAL/ACQUISITION M-X/MPS (M-X/MU.. (U) HENNINGSON DURHAM AND RICHARDSON SANTA BARBARA CA 02 OCT 81 2/4

UNCLASSIFIED M-X-ETR-13 F/G 16/1 NL


1.0
2.8
2.5
3.2
2.2
3.6
4.0
2.0
1.1
1.8
1.25
1.4
1.6

New Mexico have some form of visible emission standard; however, these regulations generally apply only to smoke or combustion-related sources. Visibility in this region is highly dependent on meteorological conditions leading to high concentrations of windblown dust.

2.2 FUTURE AIR QUALITY ENVIRONMENT WITHOUT THE M-X

NEVADA/UTAH (2.2.1)

Population projections for the Nevada/Utah region indicate an annual growth rate of 5.1 percent in the six-county region studied in Nevada, and a 3.1 annual percent growth rate projected for the seven-county area studied in Utah. Population is directly related to certain emissions, in particular NO_x, CO, and HC from vehicle use, NO_x emissions from space heating and cooling, HC from the application and storage of solvents and paints, and HC from fuel storage and use. These emissions are expected to grow in proportion to the population change. Whether or not their emission growth will result in subsequent air quality degradation depends on the location and density of emission sources and the local meteorological and topographical characteristics.

Several industrial projects are proposed in the study area that will result in emissions of unknown quantities. These projects include the General Battery Manufacturing Plant near Nephi, Utah, the Continental Lime Plant near Fillmore, Utah, and the Precision Built Modular Home Manufacturing Plant near Delta, Utah.

Proposed energy and mining development in the study region will also generate potential air emission sources. There are 21 mines proposed in the Nevada study region through 1986 (Nevada Bureau of Mines and Geology). Other proposed mining facilities in the study area include a molybdenum mining-processing facility near Minersville, Utah, a Martin-Marietta Cement Plant near Delta, Utah, an Anaconda molybdenum mine in Pine Basin, Nevada, and an alunite mine in Wah Wah Basin, Nevada. These projects are all potential pollutant emission sources that may affect existing air quality levels.

Proposed energy-related projects that will affect future baseline emissions and air quality levels include a Geothermal Power Plant near Milford, Utah, a SUFCO Coal Loading Facility near Nephi, Utah, the Intermountain Power Project in Millard County, Utah (Sevier Basin), the Allen Warner Valley Energy System near Las Vegas, Nevada, the Rocky Mountain Gas Line in Utah, the Mountain Fuel Coal Gasification Project in Utah, the Morman Mesa Solar Power Plant, Utah, and the White Pine Power Plant in White Pine County, Nevada. Further energy-related development may occur along the potentially energy-rich overthrust belt which runs along the southwestern Utah and eastern Nevada border. The development of gas and oil fields may add to pollutant levels throughout the region.

All of the above proposed projects are in NAAQS attainment areas (with the exception of Steptoe Valley in White Pine County, Nevada), therefore air quality levels will be covered by PSD regulations that allow future sources to affect existing air quality levels up to the applicable PSD increment. Almost inevitably air pollutant levels can be expected to increase as a result of future energy and industrial projects and partially consume available PSD increments for SO_2 and TSP. Additional projects will be constrained further by having less of the increment

available to consume. PSD increments or similar regulations for the remaining criteria pollutants (CO, O_3, HC, NO_x, and Pb) are expected to be designated by EPA.

In nonattainment areas, a proposed project may be required to obtain emission offsets or propose other control strategies to demonstrate a net air quality benefit before the project is approved. Existing nonattainment areas where emission offsets or other control strategies may be required include Steptoe Valley (SO_2) and Las Vegas Valley (O_3, CO, and TSP), in Nevada.

TEXAS/NEW MEXICO (2.2.2)

Future emissions in the deployment area will depend on population projections, and industrial and energy development. Population of the Texas and New Mexico region is predicted to grow at an annual rate of 1.4 and 1.5 percent, respectively, during 1980 to 1994. CO, NO_x, and HC emissions are expected to grow in proportion to the population change.

Predictions for industrial growth in the Texas/New Mexico region are uncertain. Any industrial or energy development in the area where NAAQS attainment areas exist would tend to worsen air quality levels and consume the available PSD increments. Other criteria pollutant levels may also increase as a result of industrial development.

Increases in agricultural activity may increase ambient TSP concentrations to such a level as to cause a new major source of TSP to violate the NAAQS for TSP.

3.0 AIR QUALITY MODEL DESCRIPTIONS

To simulate the air quality impact of M-X related air pollutant emissions, several air quality dispersion models were used. The IMPACT model was used to evaluate average dust concentrations for construction groups resulting from maximum levels of construction activity. A version of the IMPACT model is currently used by the California Air Resources Board for air quality impact assessments. The IMPACT model accounts for dispersion in complex terrain and computes concentrations averaged over grid cells. To calculate peak concentrations close to construction activities, the HIWAY and PAL models were used. The HIWAY model, an EPA-approved line source model, was used to compute the near-field gaseous pollutant concentrations due to vehicular traffic associated with system construction and OB operation. The PAL model, one of the EPA UNAMAP models, was used to estimate near-field impacts of construction dust from various construction elements, including roads and construction activities. Another EPA UNAMAP model, the Industrial Source Complex (ISC) model, was also used to etimate the local impacts of construction dust. The ISC model was also used to simulate the long-term effects of wind erosion during system operation. The ISC model was appropriate for this task because of its capability to simulate the settling and removal of particles from the atmosphere, thus leading to more realistic concentration estimates. The following sections give brief descriptions of the features and limitations of each of these models.

3.1 INTEGRATED MODEL FOR PLUMES AND ATMOSPHERICS IN COMPLEX TERRAIN (IMPACT)

The IMPACT computer code (Fabrick et al., 1977) is a three-dimensional grid model for calculating concentrations of inert or reactive pollutants. A major feature of the IMPACT model is its treatment of complex terrain. Topographic influences on wind flows in the modeled region are simulated such that winds are diverted around or over terrain obstacles (hills and mountains), as compared to Gaussian models which assume uniform wind direction throughout the region. The IMPACT model is capable of simulating a wide variety of meteorologic conditions characteristic of mountainous terrain: valley drainage winds, upslope winds, and variable inversion heights.

IMPACT is well suited to regional air quality analyses, and is not intended as a means of identifying localized peak concentrations. Emissions and concentrations are averaged across each grid cell, hence the resolution of the model is dependent on the selection of grid cell sizes. High resolution modeling (grid sizes of 500 meters or less) is inhibited by the amount of computer time and storage which would be required to model an area. For example, a 40 by 40 kilometer area would require 100 grid cells, each 4 kilometers square, or 1,600 grid cells each 1 kilometer square. Vertical layering can increase the precision of results, but greatly increases computer time requirements.

The IMPACT model requires three types of data before performing concentration level analysis for a given region: (1) digitized terrain information, (2) pollutant emission rate data for all locations and times modeled, and (3) hourly

meteorological data including wind speeds, mixing heights, and stability class for each meteorological site.

3.2 HIWAY

Detailed information regarding the EPA HIWAY line source computer code is available in the "User's Guide for HIWAY, A Highway Air Pollution Model" (EPA-650/4-74-008). A brief description follows:

HIWAY can be used for estimating the concentrations of nonreactive pollutants from highway traffic. This steady-state Gaussian model can be applied to determine air pollution concentrations at receptor locations downwind of "at-grade" and "cut-section" highways located in relatively uncomplicated terrain. For an at-grade highway, each lane of traffic is modeled as though it were a finite, uniformly emitting line source of pollution. For the cut section, the top of the cut is considered an area source. The area source is simulated by using ten line sources of equal source strength. The total source strength equals the total emissions from the lanes in the cut.

The air pollution concentration representative of hourly averaging times at a downwind receptor location is found by numerical integration along the length of each lane and a summing of the contributions from each lane. With the exception of receptors directly on the highway or within the cut, the model is applicable for any wind direction, highway orientation, and receptor location. The model was developed for situations in which horizontal wind flow occurs. The model does not consider complex terrain or large obstructions to the flow such as buildings or large trees.

3.3 POINT/AREA/LINE (PAL)

The "User's Guide for PAL" (EPA-600/4 - 78 - 013) contains a detailed description of the PAL model. The following is provided as a reference description:

PAL is a multisource Gaussian-Plume atmospheric dispersion algorithm for estimating concentrations of nonreactive pollutants. Concentration estimates are based on hourly source emissions data and meteorology, and averages can be computed for averaging times from 1 to 24 hours. Six source types are included in PAL: points, areas, two types of line sources, and two types of curved path sources. As many as 30 sources may be included under each source type. PAL is not intended as an areawide model but may be applied to estimate the contribution of part of an urban area or complex to the concentration at a designated receptor.

3.4 MODEL ASSUMPTIONS AND LIMITATIONS OF THE IMPACT, HIWAY AND PAL MODELS

All emissions modeled by the IMPACT, PAL and HIWAY computer codes are assumed to behave as conservative gases; i.e., gases which are nonreactive and which are not affected by physical removal processes. The assumption is most reasonable for inert or slowly reactive gaseous emissions (CO and NO_x). Fugitive dust emissions are handled in these models by assuming dust emissions behave as a gas. Airborne concentrations of dust are over-predicted as no mechanisms for removal of dust particles (through settling or impaction against the surface) are

incorporated into these models. Use of these models for larger particles can result in a severe overproduction of impacts. A more precise analysis requires a size distribution of fugitive dust particles in order to estimate the dust removal rates, and a numerical method capable of treating the physical removal of dust particles.

Concentrations reported by the IMPACT model are average values over a single grid cell. Two grid cell sizes are used in this study: 4,000 ft by 4,000 ft (for the operating base) and 4 km by 4 km (for the deployment area). The average concentration of the grid cell is useful in assessing regional effects, but does not reflect peak values or "hot spots" which may occur within a grid cell. These localized peak impacts are evaluated using the EPA HIWAY and PAL computer codes in this study.

HIWAY and PAL, as other Gaussian models, are subject to limiting assumptions including uniform, steady-state atmospheric conditions, and relatively flat terrain. Gaussian models assume that pollutant concentrations are inversely proportional to the wind speed. Unrealistically high concentration estimates are produced during very low wind speed conditions due to this inverse relationship. Other modeling difficulties are also associated with low wind speeds. For example, if wind directions are extemely variable, the hourly average wind direction used in the model may well not be a true representation of the wind direction during the hour. This problem can lead to a significant over-prediction of air quality impacts. The dispersion parameters used in HIWAY and PAL do not recognize this kind of variability in the wind thereby overestimating pollutant concentrations. Gaussian models also assume that there is no build-up of pollutants from hour to hour. That is, the concentration estimate made for a particular hour is independent of the concentration estimate made for the previous hour. This factor tends to cause pollutant concentrations to be underestimated during low wind speed conditions when residual pollutant build-up may occur, especially in urban areas.

The Pasquill-Gilford horizontal dispersion parameter values used in PAL are strictly applicable only to concentration estimates with a 3-minute averaging time (Pasquill, 1976). An increase would be expected in horizontal dispersion for the 1-hour averaging assumed in the model. No adjustments have been made in the model to account for this effect, leaving the estimates once again on the conservative side; i.e., higher than actually would occur. The dispersion parameters used are considered applicable for a generally rural environment. Care must also be exercised when comparing high hourly-average concentration estimates with longer term air quality standards, as in comparing the 1-hour concentration with the 8-hour standard. It would be unrealistic to assume that a single combination of wind direction, wind speed, and stability class, which may maximize a single hourly value, would persist during an 8-hour period. Due to the greater fluctuation of wind direction over an 8-hour period, 8-hour average concentrations will always be less than 1-hour concentrations. Similar care must be exercised when distances between the sources and receptors are such that pollutants carried by the wind would take more than one hour to cover the distance. The changes that occur in atmosphere under such conditions are not simulated well by Gaussian models.

HIWAY and PAL are both designed to make estimates over relatively level terrain. Receptor height cannot be used to simulate topographic differences since the height of the receptor is the height of that receptor above the local ground level, not the height of the ground above some reference plane.

3.5 INDUSTRIAL SOURCE COMPLEX DISPERSION MODEL

The following is an excerpt from the ISC Users Guide (Bowers et al., 1979):

"The Industrial Source Complex (ISC) Dispersion Model combines and enhances various dispersion model algorithms into a set of two computer programs that can be used to assess the air quality impact of emissions from the wide variety of sources associated with an industrial source complex. For plumes comprised of particulates with appreciable gravitational settling velocities, the ISC Model accounts for the effects on ambient particulate concentrations of gravitational settling and dry deposition. Alternately, the ISC Model can be used to calculate dry deposition. The ISC short-term model (ISCST), an extended version of Single Source (CRSTER) Model (EPA, 1977), is designed to calculate concentration or deposition values for time periods of 1, 2, 3, 4, 6, 8, 12 and 24 hours. If used with a year of sequential hourly meteorological data, ISCST can also calculate annual concentration or deposition values. The ISC long-term model (ISCLT) is a sector-averaged model that extends and combines basic features of the Air Quality Display Model (AQDM) and the Climatological Dispersion Model (CDM). The long-term model uses statistical wind summaries to calculate seasonal (quarterly) and/or annual ground-level concentration or deposition values. Both ISCST and ISCLT use either a polar or a Cartesian receptor grid. The ISC Model computer programs are written in Fortran IV and require approximately 65,000 UNIVAC 1110 computer words. The major features of the ISC Model are listed in Table 3.5-1.

"The ISC Model programs accept the following source types: stack, area and volume. The volume source option is also used to simulate line sources. The steady-state Gaussian plume equation for a continuous source is used to calculate ground-level concentrations for stack and volume sources. The area source equation in the ISC Model programs is based on the equation for a continuous and finite crosswind line source. The generalized Briggs (1971 and 1975) plume-rise equations, including the momentum terms, are used to calculate plume rise as a function of downwind distance. Procedures suggested by Huber and Snyder (1976) and Huber (1977) are used to evaluate the effects of the aerodynamic wakes and eddies formed by buildings and other structures on plume dispersion. A wind-profile exponent law is used to adjust the observed mean wind speed from the measurement height to the emission height for the plume rise and concentration calculations. Procedures utilized by the Single Source (CRSTER) Model are used to account for variations in terrain height over the receptor grid. The Pasquill-Gifford curves (Turner, 1970) are used to calculate lateral (σ_y) and vertical (σ_z) plume spread. The ISC Model has rural and urban options. In the Rural Mode, rural mixing heights and the σ_y and σ_z values for the indicated stability category are used in the calculations. In Urban Mode 1, the stable E and F stability categories are redefined as neutral D stability. In Urban

Table 3.5-1. Major features of the ISC model.

Polar or Cartesian coordinate systems.
Plume rise due to momentum and buoyancy as a function of downwind distance for stack emissions (Briggs, 1971 and 1975).
Procedures suggested by Huber and Snyder (1976) and Huber (1977) for evaluating building wake effects.
Procedures suggested by Briggs (1973) for evaluating stack-tip down-wash.
Separation of multiple point sources.
Consideration of the effects of graviatational settling and dry deposition on ambient particulate concentrations.
Capability of simulating line, volume, and area sources.
Capability to calculate dry deposition.
Variation with height of wind speed (wind-profile exponent law).
Concentration estimates for 1-hour to annual average.
Terrain-adjustment procedures for complex terrain.
Consideration of time-dependent exponential decay of pollutants.

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Mode 2, the E and F stability categories are combined and the σ_y and σ_z values for the stability category one step more unstable than the indicated stability category (except A) are used in the calculations. Urban mixing heights are used in both urban modes."

4.0 MODEL INPUTS

4.1 M-X-RELATED EMISSIONS

CONSTRUCTION SCHEDULE (4.1.1)

The construction schedule and equipment lists used in estimating emissions appear in Table 4.1.1-1 through 4.1.1-4. A map of construction groups appears in Figure 4.1.1-1. The construction schedule has been updated and is somewhat different than that presented in Table 4.1.1-1. This will not change the results of the air quality modeling. The modeling was based on a worst-case activity level at one time in a construction group. This worst-case activity level has not changed.

DEPLOYMENT AREA (4.1.2)

Particulate Emissions (4.1.2.1)

Vehicular Road Dust (4.1.2.1.1)

Fugitive Dust Emissions from Unpaved Roads Associated with M-X Construction Activities.

Road dust will be a major source of particulate emissions during the construction phase of the M-X project. Fugitive dust emission results from the many miles of construction vehicle travel over the unpaved surfaces of the cluster and DTN roads. The quantity of dust lifted into the air per given segment of road will vary linearly with the volume of traffic over the segment. In addition, the amount of emissions will depend on various factors such as vehicle speed, road surface texture, and surface moisture.

Field measurements have indicated that emissions are directly proportional to vehicle speed and to the number of wheels on the vehicle. Thus an eighteen-wheeled semi-truck carrying steel to a shelter site would raise 4.5 times as much di-t as a four-wheeled carry-all truck transporting a survey crew over the same segment of road.

The surface texture of the road is another important factor in determining the amount of dust emissions because emissions have been found to vary in direct proportion to the fraction of silt in the road surface material. Silt is defined by the American Association of State Highway Officials as particles smaller than 75 micrometers in diameter. The silt fraction is determined by measuring the proportion of loose, dry, surface dust that passes a 200-mesh screen using the ASTM-C-136 method.

Rainfall will also affect the dust emission rates. Emissions can be reduced to zero when the road surface is wet. However, unpaved roads generally have a hard, nonporous surface that dries quickly after a rainfall. This effect may be accounted for by neglecting emissions only on days with more than 0.01 in. of rainfall when the road surface is wet enough to nearly eliminate dust emissions.

Table 4.1.1-1. Construction schedule used for air quality modeling emission estimates.[1]

Segment Number	Construction Group Number	Shelters Start	Shelters End	Cluster Roads Start	Cluster Roads End	DTN Start	DTN End
	11	10/84	11/85	6/84	4/85		
	4	6/85	11/86	4/85	4/86		
1	5	7/86	8/87	4/86	1/87	1/84	4/86
	6	5/87	6/88	1/87	11/87		
	12	3/88	7/89	11/87	11/88		
	1	1/85	11/86	10/84	4/86		
2	2	8/86	2/88	4/86	6/87	5/84	7/86
	3	10/87	7/89	6/87	5/88		
	9	7/85	1/87	3/85	5/86		
	10	9/86	11/87	5/86	4/87		
3	8	7/87	10/88	4/87	2/88	10/84	1/87
	7	6/88	7/89	2/88	5/89		
	16	7/85	9/86	3/85	1/86		
4	15	5/86	9/87	1/86	1/87	10/84	9/86
	14	5/87	8/88	1/87	12/87		
	13	4/88	7/89	12/87	11/88		

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[1] Representative of a typical schedule for full deployment in either Nevada/Utah or Texas/New Mexico. Changes in schedule have minimal effect on calculation of daily emission rates for a single construction group area.

Table 4.1.1-2. DTN construction equipment list.[1]

Equipment Type	Number of Vehicles Segment 1	Segment 2	Segment 3	Segment 4
Passenger car	50	50	50	50
Carry-all	3	3	3	3
30-ton truck[2]	32	24	27	28
Spray truck	2	2	2	2
Semi	1	1	1	1
Tank truck	3	3	3	3
Water truck[3]	170	130	149	158
Off-road truck	39	31	34	36
D-5 dozer	17	13	15	16
12-G grader	44	34	39	41
Backhoe	3	2	2	3
641-B scraper	23	18	20	21
Compactor	50	38	44	46
Pipelayer	3	2	2	3
Paver	4	3	3	4
Roller	8	6	7	7

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[1]Represents preliminary estimates of the total number of each vehicle type to be allocated to the four primary construction segment areas (see Table 4.1.1-1 and Figure 4.1.1-1) for DTN road construction. Preliminary estimates used for air quality modeling calculations.

[2]30-ton trucks used for bituminous surfacing operations which occur after completion of system construction.

[3]Water trucks and spray trucks not considered as a source of fugitive road dust.

Table 4.1.1-3. Cluster road construction equipment list.[1]

Equipment Type	Number of Vehicles Segment 1	Segment 2	Segment 3	Segment 4
Passenger car	50	50	50	50
Carry-all	6	4	5	5
Semi	2	1	2	2
Tank truck	3	3	3	3
Water truck[2]	233	179	204	216
Off-road truck	73	56	64	67
641-B scraper	8	7	7	8
D-5 dozer	13	10	12	13
12-G grader	40	30	35	37
Backhoe	5	4	4	4
Spreader	1	1	1	1
Compactor	61	47	53	57
Pipelayer	5	4	4	4

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[1] Represents preliminary estimates of the total number of each vehicle type to be allocated to the four primary construction segment areas (see Table 4.1.1-1 and Figure 4.1.1-1) for cluster road construction. Preliminary estimates used for air quality modeling calculations.

[2] Water tanks not considered as a source of fugitive road dust.

4.1.1-4. Shelter construction equipment list.[1]

Equipment Type	Number of Vehicles Segment 1	Segment 2	Segment 3	Segment 4
Passenger car	50	50	50	50
Carry-all	3	2	2	3
32-ton truck	3	3	3	3
Concrete truck	50	39	44	47
Semi	2	1	1	1
Water truck[2]	224	171	196	208
Flatbed truck	12	10	11	11
D-5 dozer	10	7	8	9
Compactor	3	2	2	3
D-9 with ripper	4	4	4	4
641-B scraper	6	5	5	5
12-G grader	2	1	1	1

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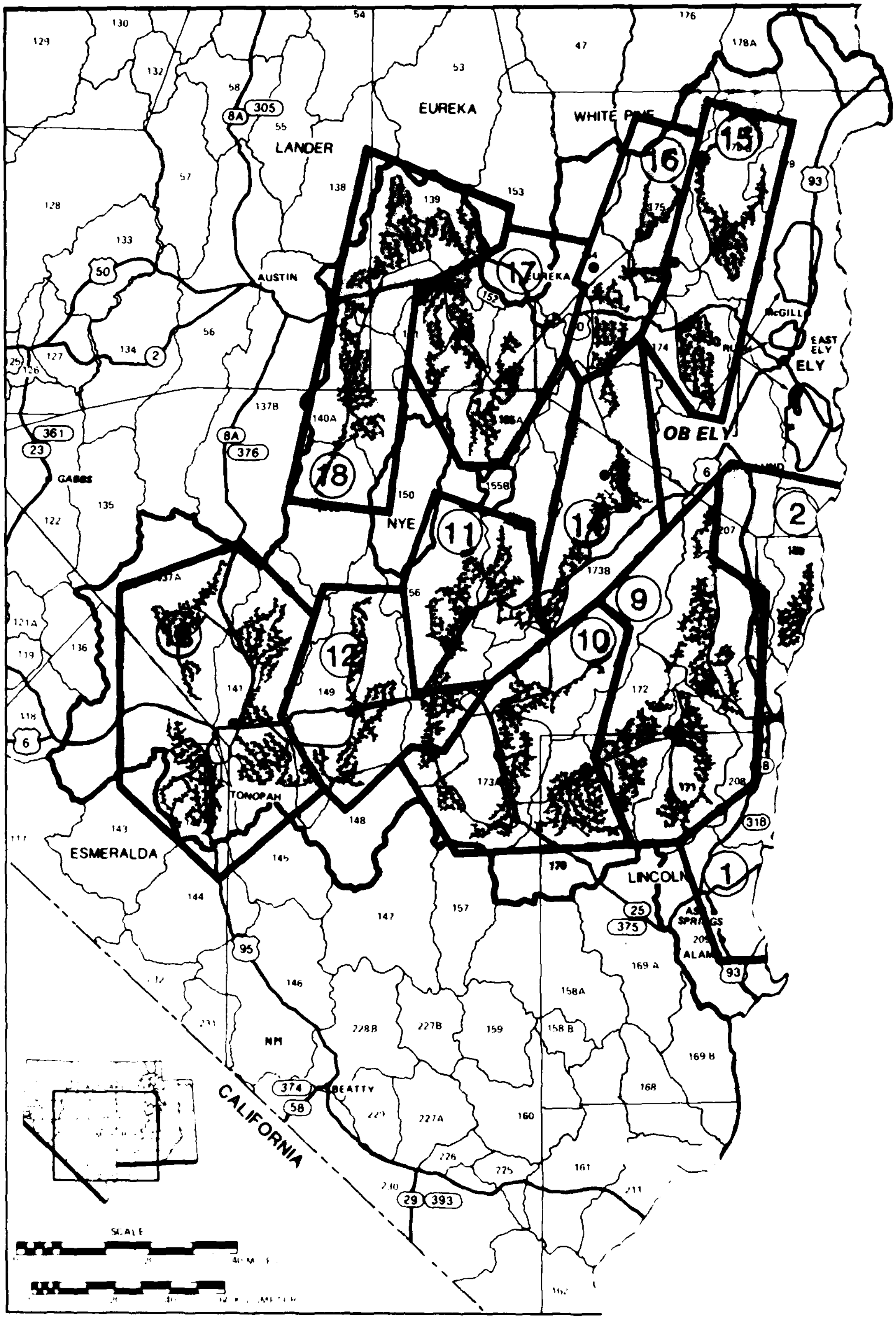
[1]Represents preliminary estimates of the total number of each vehicle type to be allocated to the four primary construction segment areas (see Table 4.4.1-1 and Figure 4.1.1-1) for shelter construction. Preliminary estimates used for air quality modeling calculations.

[2]Water trucks not considered as a source of fugitive road dust.



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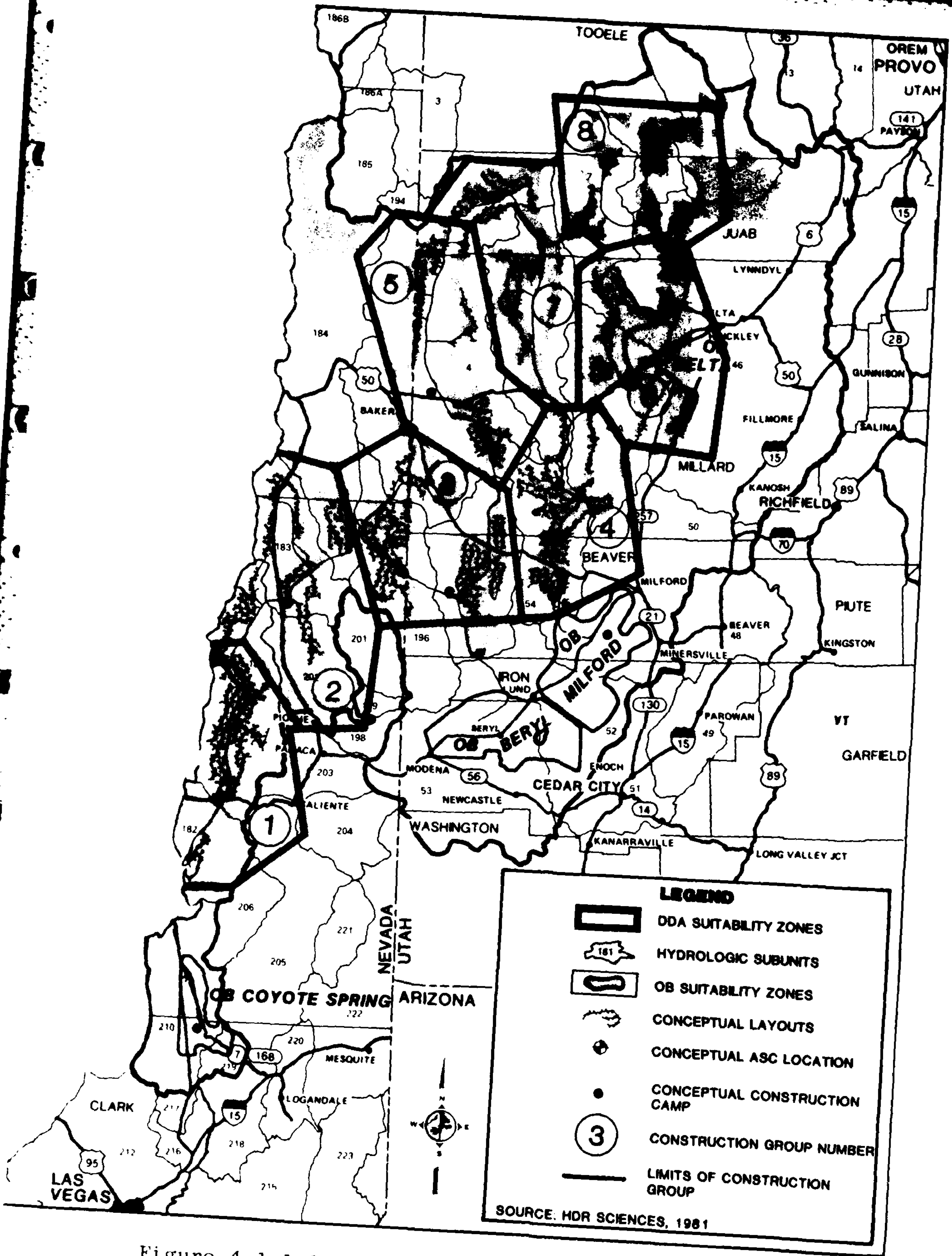

Figure 4.1.1-1. Nevada/Utah construction layout used for air quality modeling.

The quantity of fugitive dust emissions from an unpaved road, per vehicle-mile of travel, may be estimated (within 20 percent) using the following empirical expression:

$$E = (0.81s) \frac{S}{30} \frac{365-w}{365} \frac{t}{4} \qquad (1).$$

where:

E	=	Emission factor, pounds per vehicle-mile
s	=	Silt content of road surface material, percent
S	=	Average vehicle speed, miles per hour
w	=	Mean annual number of days with 0.01 in. or more of rainfall.
t	=	Number of wheels on vehicle.

The equation is valid for vehicle speeds in the range of 30 to 50 mi/hr (US E.P.A., 1977).

As a first step approximation, the above emission factor has been calculated as a minimum and maximum value for the conditions expected in the M-X Nevada/Utah proposed deployment area. These minimum and maximum factors have then been used to determine "best case" and "worst case" emissions which would result for a particular construction schedule which specifies type of equipment and length of construction activity for each of the major construction scenarios (shelter construction, DTN construction, and cluster road construction).

Cluster roads, and initially the DTN roads, will be formed by the spreading of an aggregate, gravel-like material. Studies have shown that the silt content of gravel roads averages about 12 percent. The amount of silt in the road surface material was therefore estimated to range between 8 and 20 percent as minimum and maximum values possible. This range is in accord with good engineering practice which requires this same range for the silt content found in a gravel road. Less than 8 percent silt content causes loss of cohesion properties. More than 20 percent silt content reduces the stability of the surface.

Estimates of the daily average speed rates of the construction equipment over the roadway surfaces were assumed to vary from 30 to 45 mi/hr. Dust emissions increase with increased vehicle speed. Therefore, 45 mi/hr is the conservative emission estimate.

The mean annual number of days with 0.01 in. or more of rainfall is 40 to 90 days for the Nevada/Utah proposed deployment area as determined from a figure given in the Climatic Atlas of the United States. The number of days with 0.01 in. or more of rainfall was reduced by a factor of five-sevenths (0.714) because concern was only with road dust emission on construction days. Construction is assumed to take place five days a week, eight hours a day. The minimum and maximum values of significant rainfall days therefore become 29 and 64, respectively.

Using the above ranges for the correction parameters, the minimum and maximum values of the fugitive dust emission factor were calculated with Equation 1.

$$E_{min} = 0.81(8)\ \frac{30}{30}\ \frac{365-64}{365}\ \frac{4}{4}$$

$$= 5.34 \text{ lbs/vehicle-mile}$$

$$E_{max} = 0.81(20)\ \frac{45}{30}\ \frac{365-29}{365}\ \frac{4}{4}$$

$$= 22.40 \text{ lbs/vehicle-mile} \qquad (2).$$

These emission factors are used in conjunction with specific construction schedules (number of construction days) and equipment allocations (number of vehicles and mi/day traveled) to determine the total ground-level dust emissions for either the total project area, construction segment area, or cluster group area. Tables 4.1.2-1 through 4.1.2-3 present worst-case road dust emissions for each construction segment due to DTN, cluster road, or shelter construction. A more specific analysis could only be achieved by the use of correction parameters dependent on the particular site in question.

Special considerations are needed to determine the fraction of the total emissions that will remain suspended for a long time in comparison to the time of air quality model calculations. The potential drift distance of particles is governed by the initial injection height of the particle, the particle's terminal settling velocity, and the degree of atmospheric turbulence. Theoretical drift distances, as a function of particle diameter and mean wind speed, have been computed for unpaved road emissions. These results indicate that, for a typical mean wind speed of 10 mi/hr, particles larger than about 100 micron are likely to be deposited on the ground within 30 ft from the edge of the road. Dust that settles within this distance is not included in Equation 1. Particles that are 30 to 100 micrometers (μ) in diameter are likely to undergo settling within a few hundred meters from the road edge. Smaller particles, particularly those less than 15μ in diameter, have much slower gravitational settling velocities and are much more likely to have their settling rate retarded by atmospheric turbulence. Thus, based on the presently available data, it is appropriate to report only those particles smaller than 30μ as emissions that may remain suspended for a long time (hereafter referred to as suspended dust). For gravel roads, approximately 62 percent of the emissions predicted by Equation 1 would be particles less than 30μ. Tables 4.1.2-4 through 4.1.2-6 summarize the mitigated and unmitigated emission rates of suspended fugitive road dust particulates. The tables identify rates for each activity taking place within the four major construction segments (see Table 4.1.1-1 and Figure 4.1.1-1 for layout description). Each construction area (designated as a construction group) within a given segment is subject to the same average emission rate for a particular activity because the same equipment is being used for each group within the segment. Note also that the best case rates have been reduced by half on the assumption that watering will take place in sufficiently frequent intervals to provide 50 percent effective control.

Probable Case Road Dust Emission Rates

The emission scenario used in modeling the fugitive dust impacts of construction consisted of probable case emission rates occuring at a time of maximum construction activity in a construction group (see Section 5.1.5). Activities occuring at this time include shelter construction, cluster road

Table 4.1.2-1. Road dust emissions associated with DTN construction.[1]

Segment Number	Vehicle Type	a. Number of Vehicles	b. Distance Traveled (mi/day)	c. Wheel Correction Factor	d. Number of Construction Days	Dust Emissions Per Day (tons) (a)x(b)x(c)xE.F.[2]	Total Dust Emissions (tons) (a)x(b)x(c)x(d)xE.F.[2]
1	Offroad truck	40	240	8/4 = 2.0[3]	586	215.0	126,013
	Semi	1	500	18/4 = 4.5	586	25.2	14,767
	Tank truck	3	500	16/4 = 4.0	586	67.2	39,379
	Passenger	50	100	4/4 = 1.0	586	56.0	32,816
Subtotal						363.4	212,975
2	Offroad truck	30	240	8/4 = 2.0[3]	564	161.3	90,962
	Semi	1	500	18/4 = 4.5	564	25.2	14,213
	Tank truck	3	500	16/4 = 4.0	564	67.2	37,901
	Passenger	50	100	4/4 = 1.0	564	56.0	31,584
Subtotal						309.7	174,660
3	Offroad truck	34	240	8/4 = 2.0[3]	586	182.8	107,111
	Semi	1	500	18/4 = 4.5	586	25.2	14,767
	Tank truck	3	500	16/4 = 4.0	586	67.2	39,379
	Passenger	50	100	4/4 = 1.0	586	56.0	32,816
Subtotal						331.2	194,073
4	Offroad truck	36	240	8/4 = 2.0[3]	500	193.5	96,768
	Semi	1	500	18/4 = 4.5	500	25.2	12,600
	Tank truck	3	500	16/4 = 4.0	500	67.2	33,600
	Passenger	50	100	4/4 = 1.0	500	56.0	28,000
Subtotal						341.9	170,968
Total						1,346.2	752,676

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[1] Assumes 100 percent equipment operation throughout entire time period of segment construction and use of maximum emission factor.

[2] E.F. (Emission Factor) = 0.0112 ton/vehicle-mile. Based on 20 percent silt content, 45 mi/hr average speed, and 29 days average speed, and 29 days with more than 0.01 in. of rainfall.

Table 4.1.2-2. Road dust emissions associated with cluster road construction.[1]

Segment Number	Vehicle Type	a. Number of Vehicles	b. Distance Traveled (mi/day)	c. Wheel Correction Factor	d. Number of Construction Days	Dust Emissions Per Day (tons) (a)x(b)x(c)xE.F.[2]	Total Dust Emissions (tons) (a)x(b)x(c)x(d)xE.F.[2]
1	Tank truck	3	500	16/4 = 4.0	1,151	67.2	77,347
	Offroad truck	73	240	8/4 = 2.0[3]	1,151	392.4	451,708
	Semi	2	500	18/4 = 4.5	1,151	50.4	58,010
	Passenger	50	100	4/4 = 1.0	1,151	56.0	64,456
Subtotal						566.0	651,521
2	Tank truck	3	500	16/4 = 4.0	934	67.2	62,765
	Offroad truck	56	240	8/4 = 2.0[3]	934	301.1	281,186
	Semi	1	500	18/4 = 4.5	934	25.2	23,537
	Passenger	50	100	4/4 = 1.0	934	56.0	52,304
Subtotal						449.6	419,792
3	Tank truck	3	500	16/4 = 4.0	1,020	67.2	68,544
	Offroad truck	64	240	8/4 = 2.0[3]	1,020	344.0	350,945
	Semi	2	500	18/4 = 4.5	1,020	50.4	51,408
	Passenger	50	100	4/4 = 1.0	1,020	56.0	57,120
Subtotal						517.6	528,017
4	Tank truck	3	500	16/4 = 40	956	67.2	64,243
	Offroad truck	67	240	8/4 = 2.0[3]	956	360,2	344,344
	Semi	2	500	18/4 = 4.5	956	50.4	48,182
	Passenger	50	100	4/4 = 1.0	956	56.0	53,536
Subtotal						533.8	510,305
Total						2,067.0	2,109,635

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[1]Assumes 100 percent equipment operation throughout entire time period of segment construction and use of maximum emission factor.

[2]E.F. (Emission Factor) = 0.0112 ton/vehicle-mile. Based on 20 percent silt content, 45 mi/hr average speed, and 29 days with more than 0.01 in. of rainfall.

[3]Eight wheels assumed instead of the actual 4 because of massive size.

Table 4.1.2-3. Road dust emissions associated with shelter construction.[1]

Segment Number	Vehicle Type	a. Number of Vehicles	b. Distance Traveled (mi/day)	c. Wheel Correction Factor	d. Number of Construction Days	Dust Emissions Per Day (tons) (a)x(b)x(c)xE.F.[2]	Total Dust Emissions (tons) (a)x(b)x(c)x(d)xE.F.[2]
1	32-ton truck	3	500	18/4 = 4.5	1,239	75.6	93,668
	Concrete truck	50	150	6/4 = 1.5	1,239	126.0	156,114
	Semi	2	500	18/4 = 4.5	1,239	50.4	62,446
	Passenger	50	100	4/4 = 1.0	1,239	56.0	69,384
Subtotal						308.0	381,612
2	32-ton truck	3	500	18/4 = 4.5	1,173	75.6	88,679
	Concrete truck	39	150	6/4 = 1.5	1,173	98.3	115,282
	Semi	1	500	18/4 = 4.5	1,173	25.2	29,560
	Passenger	50	100	4/4 = 1.0	1,173	56.0	65,688
Subtotal						255.1	299,209
3	32-ton truck	3	500	18/4 = 4.5	1,043	75.6	78,851
	Concrete truck	44	150	6/4 = 1.5	1,043	110.9	115,648
	Semi	1	500	18/4 = 4.5	1,043	25.2	26,284
	Passenger	50	100	4/4 = 1.0	1,043	56.0	58,408
Subtotal						267.7	279,191
4	32-ton truck	3	500	18/4 = 4.5	1,043	75.6	78,851
	Concrete truck	47	150	6/4 = 1.5	1,043	118.4	123,533
	Semi	1	500	18/4 = 4.5	1,043	25.2	26,284
	Passenger	50	100	4/4 = 1.0	1,043	56.0	58,408
Subtotal						275.2	287,076
Total						1,106.0	1,247,088

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[1]Assumes 100 percent equipment operation throughout entire time period of segment construction and use of maximum

[2]E.F. (Emission Factor) = 0.0112 ton/vehicle-mile. Based on 20 percent silt content, 45 mi/hraverage speed, and 29 days with more than 0.01 in. of rainfall.

Table 4.1.2-4. Suspended fugitive road dust emission rates-summary tables, Nevada/Utah deployment area.

Segment Number	Group Number	Construction Time Period (No. Working Days)		DTN Construction[1] "Best Case"[2] Emission Rate Tons/Day (Tonnes/Day)	"Worst Case"[3] Emission Rate Tons/Day (Tonnes/Day)
1	11	1/84-6/84	(105)	20.6 (18.7)	172.6 (156.5)
	4	6/84-12/84	(136)	20.6 (18.7)	172.6 (156.5)
	5	12/84-4/85	(94)	20.6 (18.7)	172.6 (156.5)
	6	4/85-10/85	(115)	20.6 (18.7)	172.6 (156.5)
	12	10/85-4/86	(136)	20.6 (18.7)	172.6 (156.5)
2	1	5/84-3/85	(210)	16.6 (15.1)	139.3 (126.3)
	2	3/85-10/85	(157)	16.6 (15.1)	139.3 (126.3)
	3	10/85-7/86	(197)	16.6 (15.1)	139.3 (126.3)
3	9	10/84-6/85	(179)	18.2 (16.5)	152.6 (138.4)
	10	6/85-1/86	(144)	18.2 (16.5)	152.6 (138.4)
	8	1/86-7/86	(132)	18.2 (16.5)	152.6 (138.4)
	7	7/86-1/87	(132)	18.2 (16.5)	152.6 (138.4)
4	16	10/84-3/85	(115)	19.0 (17.2)	159.3 (144.5)
	15	3/85-9/85	(134)	19.0 (17.2)	159.3 (144.5)
	14	9/85-3/86	(125)	19.0 (17.2)	159.3 (144.5)
	13	3/86-9/86	(125)	19.0 (17.2)	159.3 (144.5)

T4154/8-28-81

[1]Emission rates reported as average values over entire lifetime of construction activity (cluster road or DTN) within a segment. Asumes 100 percent allocated equipment operation throughout group construction periods.

[2]Based on emission factor of 5.3 lbs. of dust per vehicle per mile of travel. Watering is used as a control measure and assumed to be 50 percent effective.

[3]Based on emission factor of 22.4 lbs. of dust per vehicle per mile of travel.

Note: Semi-trucks, 32-ton trucks, and tank trucks assumed to travel only 40 miles of 500 mile daily trips within a single group area.

Table 4.1.2-5. Suspended fugitive road dust emission rates-summary tables. Nevada/Utah deployment area.

Segment Number	Group Number	Construction Time Period (No. Working Days)	Cluster Road Construction[1] "Best Case" Emission Rate[2] Tons/Day (Tonnes/Day)	"Worst Case" Emission Rate[3] Tons/Day (Tonnes/Day)
1	11	6/84-4/85 (216)	33.9 (30.7)	284.0 (257.6)
	4	4/85-4/86 (261)	33.9 (30.7)	284.0 (257.6)
	5	4/86-1/87 (195)	33.9 (30.7)	284.0 (257.6)
	6	1/87-11/87 (216)	33.9 (30.7)	284.0 (257.6)
	12	11/87-11/88 (261)	33.9 (30.7)	284.0 (257.6)
2	1	10/84-4/86 (391)	27.0 (24.5)	225.9 (204.9)
	2	4/86-6/87 (304)	27.0 (24.5)	225.9 (204.9)
	3	6/87-5/88 (239)	27.0 (24.5)	225.9 (204.9)
3	9	3/85-5/86 (304)	30.3 (27.5)	253.9 (230.3)
	10	5/86-4/87 (239)	30.3 (27.5)	253.9 (230.3)
	8	4/87-2/88 (216)	30.3 (27.5)	253.9 (230.3)
	7	2/88-2/89 (261)	30.3 (27.5)	253.9 (230.3)
4	16	3/85-1/86 (216)	31.5 (28.6)	264.1 (239.5)
	15	1/86-1/87 (261)	31.5 (28.6)	264.1 (239.5)
	14	1/87-12/87 (239)	31.5 (28.6)	264.1 (239.5)
	13	12/87-11/88 (239)	31.5 (28.6)	264.1 (239.5)

T5275/9-22-81/F

[1]Emission rates reported as average values over entire lifetime of construction activity (cluster road or DTN) within a segment. Asumes 100 percent allocated equipment operation throughout group construction periods.

[2]Based on emission factor of 5.3 lbs. of dust per vehicle per mile of travel. Watering is used as a control measure and assumed to be 50 percent effective.

[3]Based on emission factor of 22.4 lbs. of dust per vehicle per mile of travel.

Note: Semi-trucks, 32-ton trucks, and tank trucks assumed to travel only 40 miles of 500 mile daily trips within a single group area.

Table 4.1.2-6. Suspended fugitive road dust emission rates-summary tables. Nevada/Utah deployment area.

Segment Number	Group Number	Construction Time Period (No. Working Days)		Shelter Construction[1] "Best Case" Emission Rate[2] Tons/Day (Tonnes/Day)	"Worst Case" Emission Rate[3] Tons/Day (Tonnes/Day)
1	11	10/84-11/85	(292)	11.3 (10.2)	94.5 (85.7)
	4	6/85-11/86	(369)	11.3 (10.2)	94.5 (85.7)
	5	7/86-8/87	(282)	11.3 (10.2)	94.5 (85.7)
	6	5/87-6/88	(282)	11.3 (10.2)	94.5 (85.7)
	12	3/88-7-89	(347)	11.3 (10.2)	94.5 (85.7)
2	1	1/85-11/86	(477)	10.6 (9.6)	89.2 (80.9)
	2	8/86-2/88	(391)	10.6 (9.6)	89.2 (80.9)
	3	10/87-7/89	(456)	10.6 (9.6)	89.2 (80.9)
3	9	7/85-1/87	(391)	10.4 (9.4)	86.8 (78.7)
	10	9/86-11/87	(304)	10.4 (9.4)	86.8 (78.7)
	8	7/87-10/88	(326)	10.4 (9.4)	86.8 (78.7)
	7	6/88-7/89	(282)	10.4 (9.4)	86.8 (78.7)
4	16	7/85-9/86	(304)	10.8 (9.8)	90.6 (82.2)
	15	5/87-9/87	(347)	10.8 (9.8)	90.6 (82.2)
	14	5/87-8/88	(326)	10.8 (9.8)	90.6 (82.2)
	13	4/88-7/89	(326)	10.8 (9.8)	90.6 (82.2)

T5276/9-22-81/F

[1]Emission rates reported as average values over entire lifetime of construction activity (cluster road or DTN) within a segment. Asumes 100 percent allocated equipment operation throughout group construction periods.

[2]Based on emission factor of 5.3 lbs. of dust per vehicle per mile of travel. Watering is used as a control measure and assumed to be 50 percent effective.

[3]Based on emission factor of 22.4 lbs. of dust per vehicle per mile of travel.

Note: Semi-trucks, 32-ton trucks, and tank trucks assumed to travel only 40 miles of 500 mile daily trips within a single group area.

construction, and materials processing. Road dust will be generated due to traffic associated with cluster roads and shelter construction. The probable case emission rate used for calculating road dust emissions is defined as follows.

$\underline{E} \quad = \quad \underline{12.7 \text{ lb/vehicle-mile}}$

Probable case assumes:

s	=	12 percent
S	=	45 mph
w	=	47 days

<u>Road Dust from Cluster Roads Construction</u>

$$284^* \times \frac{12.7}{22.4} = 161 \text{ tons/day}$$

(*Worst-case values from Table 4.1.2-5)

161 tons/day = 5,072 g/sec

Assume 75 percent of cluster road construction vehicle travel is on DTN roads to batch plant and aggregate storage facilities:

5,072 x 0.25	=	1,268 g/sec dist. on cluster roads
5,072 x 0.75	=	3,804 g/sec dist. on DTN

Watering of roads is assumed to be 50 percent effective, oiling 90 percent effective,

1,268 x 0.5	=	634 g/sec on cluster roads after watering
3,804 x 0.1	=	380 g/sec on DTN after oil

<u>Road Dust from Shelter Construction</u>

$$94.5^* \times \frac{12.7}{22.4} = 53.6 \text{ tons/day} = 1.688 \text{ g/sec}$$

(*Worst-case values from Table 4.1.2-6)

Assume 75 percent of shelter construction vehicle travel is on DTN roads to batch plant and aggregate storage facilities:

1,688 x 0.25 x 0.5 = 211 g/sec on cluster roads in shelter area after watering

1,688 x 0.75 x 0.1 = 127 g/sec on DTN after oil

Total to spread out on DTN = 380 + 127 = 507 g/sec.

<u>Construction Activity Fugitive Dust</u> (4.1.2.1.2)

Particulate Emissions due to Shelter, Cluster, and DTN Construction Activities

Dust is evolved during land clearing, blasting, ground excavation, cut-and-fill operations, and the construction of the shelters, cluster, and DTN roads. The AP-42

unmitigated emission factor used to calculate construction emissions is 1.2 tons per acre of construction per month of activity. This factor is to be used for normal construction activity rates similar to shopping center construction. M-X construction activities are expected to proceed at a more intensive pace than normal construction, so the emission factor was increased by 50 percent (1.8 tons per acre of construction per month of activity). The emission factor was reduced by 25 percent for the reasonable mitigated case by assuming the use of water applications as a dust control measure. Table 4.1.2-7 indicates the estimated acreage disturbed per unit of roadway or per shelter constructed. Construction activity emissions were calculated using total acreage disturbed figures for each construction group based on miles of road or number of shelters within the group. The above-described construction activity emission estimates include only particles smaller than 30μ in diameter.

Probable-case emission rates refer to the implementation of a mitigation program (as identified in EPA's AP-42) to reduce construction activity emission rates by 25 percent. Chemical stabilizers are recommended for use after construction to reduce particulate emissions from exposed surfaces. As with road dust from vehicles, the specific quantities of water required to reduce emissions by up to 50 percent are not known since information on the effectiveness and type of dust palliatives to be used, application rates, and site-specific data is not available at this time.

<u>Stationary Sources (Excavation, Production, and Processing of Construction Materials)</u> (4.1.2.1.3)

Particulate Emissions from the Excavation, Production, and Processing of Shelter, Cluster, and DTN Construction Materials

Particulate emissions occur during the excavation, production, and processing of certain materials needed for construction of the M-X shelters, cluster roads, and DTN roads. Bituminous surface, concrete, and aggregate-base materials will all be excavated, produced, or processed to some degree locally, causing particulate emissions. This section describes the emissions estimates for the activities associated with providing these materials. Construction activities involving these materials are listed in Table 4.1.2-8. An estimate of the quantity of materials to be processed is necessary to determine the potential emissions for each activity. The materials required for an alternative were derived from materials estimates that used the 100 percent Nevada/Utah System 1 Alternative with 6,000 ft spacing; critical factors for the purposes of deriving emissions estimates do not vary significantly for average construction groups for most alternatives. Materials estimated for the Nevada/Utah system layout are listed in Table 4.1.2-9. One hundred percent of the bituminous surface and concrete needed was assumed to be processed or produced locally. Also, 100 percent of the aggregate material needed for aggregate base, bituminous surface, and concrete material was assumed to be excavated and processed locally.

It was assumed that 100 percent of the final material required by weight (as discussed above) was processed, produced, or excavated during each activity. This assumption may slightly overestimate (by no more than 10 percent) total emissions.

Table 4.1.2-7. Acreage disturbed per unit of DTN or cluster road or per shelter constructed.

Item	Acreage Disturbed
DTN road	12 acres/mile of road
Cluster road	12 acres/mile of road
Shelters	10 acres/shelter

T4155/9-26-81

Table 4.1.2-8. Excavation, production, and processing activities required for construction of shelters, cluster roads, and DTN roads.

Material	Construction Use	Excavation, Production, and Processing Required
Aggregate base	DTN roads Cluster roads	Sand and gravel processing plants. Aggregate storage piles. Stone quarrying and processing planmts.
Bituminous surface	DTN roads	Sand and gravel processing plants. Aggregate storage piles. Asphaltic concrete plants. Stone quarrying and processing plants.
Concrete	Shelters	Sand and gravel processing plants. Concrete batching plants. Aggregate storage piles. Stone quarrying and processing plants.

T1056/8-28-81

Table 4.1.2.-9. Materials assumed for emission estimates from road and shelter material processing.[1]

Materials	Cluster Roads		DTN's		Shelters	
	Per Mile	Total (7,000 Miles)	Per Mile	Total (1,380 Miles)	Per Shelter	Total (4,600 Shelters)
Aggregate base (cy)	9.4×10^3	6.6×10^7	8.2×10^3	1.1×10^7	0	0
Bituminous surfacing (tons)	0	0	5.1×10^3	7.0×10^6	0	0
Concrete (cy)	0	0	0	0	1.3×10^3	5.9×10^6

T1054/9-18-81/F

[1]Materials estimates were derived using the 100 percent Nevada/Utah alternative with 6,000 ft spacing between shelters. Critical factors for the purposes of deriving emissions estimates do not vary significantly for average construction groups for most alternatives.

Daily emission rates were determined by assuming that construction activities will occur at an average daily rate for each construction group and construction mode. Actual daily emission rates may vary an undetermined amount from the average daily rate calculated here, due to operation schedule variations. The estimated daily rates are given to indicate the potential average daily emission rate if plants are operated at a steady rate from start-up to completion date.

Emissions are estimated considering either "no emission controls" or "probable emission controls" applied when emission factors are given for both options. Control techniques for the activities discussed are described in Section 5.6.

Emissions for aggregate storage piles depend largely on the size (acreage) of the facility and on Thornthwaite's precipitation-evaporation (PE) index. The Thornthwaite's PE index indicates the potential for soil or aggregate particles to dry and be removed from a surface. The PE index is higher (wetter) for the Texas/New Mexico region than for the Nevada/Utah region indicating that the fugitive dust potential from aggregate storage piles is greater in the Nevada/Utah region. Aggregate storage pile emissions are the only emission factors in this section that provide compensation for geographic variability. However, the PE index and other geographically varying factors, such as wind speed, will affect emission rates for the other construction activities discussed here to an undetermined degree.

Aggregate base, bituminous surface, and concrete materials required for each construction mode are listed previously in Table 4.1.2-9. Materials handled are multiplied by emission rates in Tables 4.1.2-10 and 4.1.2-11 to derive M-X-specific emission rates.

Emission rates for each construction group were calculated, assuming that each group will have one plant of each type to handle all of the materials needed for that construction group and would store 100 percent of the aggregate-base material in piles in the area of the plants.

Total daily particulate emission rates for the local production, processing, and excavation of materials at the Dry Lake/Delamar construction camp are given in Tables 4.1.2-10 and 4.1.2-11 for probable-case and worst-case conditions. The "probable" case emissions represent effective control techniques applied to aggregate storage piles, asphaltic concrete plants, and concrete batching plants. "No control" case represents uncontrolled emissions for aggregate storage piles, asphaltic concrete plants, and concrete batching plants. Sand and gravel processing plant emissions are the same for both cases. PE index for both emissions estimates are for the Nevada/Utah region (conservative value). Dry Lake/Delamar emission estimates are presented as representative emission rates for most construction groups.

Particle-size data for emissions estimates are available for aggregate storage pile emissions. There are no data on particle size distributions for the remaining emission sources discussed here. Distribution of particle sizes varies depending on the particle-size distribution of the materials used and other factors.

Shelter and cluster road construction run concurrently for a time (one to six months). Therefore, a cumulative worst-case emission rate will occur when shelter construction daily emissions are added to cluster construction daily emissions during

Table 4.1.2.-10. Particulate emissions for stationary sources in the Dry Lake/Delamar construction group: uncontrolled case (worst case) during period of greatest construction activity.

Source	Uncontrolled Case Material (tons) or Area	Emission Rate (lb/ton)	Total Emissions (tons)	Daily Emission (tons/day)	Emission Rate (g/sec)
Shelters (282 days)					
Sand and Gravel Processing	2.99E + 05	0.1[1]	14.95	0.053	0.67
Stone Quarrying and Processing	2.99E + 05	1.6[2]	231.73	0.822	25.88
Concrete Batching Plants	2.99E + 05[4]	0.2[3]	29.9	0.101	3.34
DTN					
No construction during this period					
Clusters (216 days)					
Sand and Gravel Processing	3.455E + 06	0.1[1]	172.75	0.799	25.19
Stone Quarrying and Processing	3.455E + 06	0.4[5]	691.00	3.199	100.77
Aggregate and Storage Piles					
8 a.m. to 4 p.m.	30 acres	--	--	7.20	226.9
8 a.m. to 4 p.m. (wind erosion only)	30 acres	--	--	2.02	32.0

T4141/9-19-81

[1] Same as probable case rate.

[2] Stone quarrying and processing for shelters involves primary crushing, secondary crushing, recrushing and screening. Emission rates for these processes range from 0.1 to 2.5 lb per ton of material.

[3] Value is in lb/yd (1 yd^3 approximately equal to 2 tons).

[4] Value is in yd^3.

[5] Stone quarrying and processing for clusters involves primary crushing and secondary screening. Emission rates for these processes range from 0.1 to 0.6 lb per ton of material.

Table 4.1.2-11. Particulate emissions for stationary sources in the Dry Lake/Delamar construction group: probable case during highest construction activity.

Source	Material (tons or Area)	Emission Rate (lb/ton)	Total Emissions (tons)	Daily Emission Rate (tons/day)	Emission Rate (g/sec)
	Probable Case				
Shelters (282 days)					
Sand and gravel processing	2.99E + 05	0.1[1]	14.95	0.053	0.67
Stone quarrying & processing	2.99E + 05	0.4[2]	59.80	0.212	6.68
Concrete batching plants	2.99E + 05[4]	0.11[3]	16.45	0.058	1.84
DTN					
No construction during this period					
Clusters (216 days)					
Sand and gravel processing	3.455E + 06	0.1[1]	172.75	0.799	25.19
Stone quarrying and processing	3.455E + 06	0.1[5]	172.75	0.799	25.19
Aggregate storage piles[6]					
8 am to 4 pm	30 acres	--	--	4.32	136.3
Total 8 am to 4 pm					195.9
Aggregate storage piles[7]					
4 pm to 8 am (wind erosion only)	30 acres	--	--	0.81	12.8

T3496/10-2-81

[1]Same as uncontrolled rate.

[2]75% effective control (w/cyclone); reduces emissions from 1.6 to 0.4 lb per ton of material.

[3]Control between 0.2 and 0.02 lb/yd possible; 50% control assumed.

[4]Value is in yd^3 (1 yd^3 approximately equal to 2 tons).

[5]75% effective control reduces emissions from 0.4 to 0.1 lb/ton.

[6]40% effective control possible (uncontrolled rate = 226.9 g/sec).

[7]60% effective control possible (uncontrolled rate = 32.0 g/sec).

the overlapping period. DTN construction emissions are expected to be emitted exclusively during the approximately seven-month period prior to cluster road or shelter road construction start-up and after completion of the shelters and cluster roads.

Aggregate Storage Operations (4.1.2.1.4)

Emissions from aggregate storage operations consist of emissions from loading and unloading activities, vehicle traffic, and wind erosion of the aggregate storage pile and disturbed surfaces. The following calculations assme a 30 acre facility that is operating between 8 a.m. and 4 p.m. From 4 p.m. to 8 a.m. only wind erosion emissions occur.

1) based upon normal activity emission factor (5 days a week): Guideline Series, 1977, Fugitive Dust:

$$\text{Emission Factor*} = \frac{10.4}{\left(\frac{PE}{100}\right)^2} = \frac{10.4}{\left(\frac{13}{100}\right)^2} = 615.4 \ \frac{\text{lb}}{\text{day-acre}}$$

where: PE = Thornthwaite Precipitation - Evaporation Index

2) Daily emissions (over all 24 hours)

$$615.4 \ \frac{\text{lb}}{\text{day-acre}} \times 30 \text{ acres} = 18{,}462 \ \frac{\text{lb}}{\text{day}}$$

3) Emissions 8 a.m. - 4 p.m.

The following estimates of total emissions during daytime operations were derived with the use of Table 1.1.2.3-1 in USEPA Document No. 275-525, August, 1977.

$$\text{Emissions from loading and unloading} = \frac{12{,}369.5 \text{ lb}}{8 \text{ hr}} = 1{,}546.2 \text{ lb/hr}$$

$$\text{Emissions from wind erosion} = \frac{2{,}023.4 \text{ lb}}{8 \text{ hr}} = \underline{252.9 \text{ lb/hr}}$$

$$\text{total} = 1{,}799.1 \text{ lb/hr}$$

4) Emissions 4 p.m. - 8 a.m.

$$\text{Emissions from wind erosion only} = \frac{4{,}046.9 \text{ lb}}{16 \text{ hr}} = 252.9 \text{ lb/hr}$$

5) Emission rates (g/sec)

$$\text{8 a.m. - 4 p.m.} = 1{,}799.1 \text{ lb/hr} \times \frac{1 \text{ hr}}{3600 \text{ sec}} \times \frac{454 \text{ g}}{\text{lb}} = 226.9 \text{ gm/sec}$$

4 p.m. - 8 a.m. (only wind erosion emissions):

$$252.9 \text{ lb/hr} \times \frac{1 \text{ hr}}{3600 \text{ sec}} \times \frac{454 \text{ g}}{\text{lb}} = 32.0 \text{ gm/sec}$$

Wind Erosion from Exposed Surface (4.1.2.1.5)

The basic equation used to calculate wind erosion losses as given in OAQPS Guideline Series No. 1.2-071, October, 1977 is:

$$E_s = AIKCL'V'$$

where:

- E_s = suspended particulate fraction of wind erosion losses, tons/acre/year
- A = portion of total wind erosion losses that would be measured as suspended particulate
- I = soil erodibility, tons/acre/year
- K = surface roughness factor
- C = climatic factor
- L' = unsheltered field width factor
- V' = vegetative cover factor

The OAQPS Guideline Series suggests a value of 0.038 for variable A as typical of disturbed native soil. The EPA report, "Investigation of Fugitive Dust - Sources, Emissions and Control," May, 1973 prepared by PEDCO assumes that an aver- - of 2.5 percent of wind erosion soil losses become suspended particulates.

Variable I, the erodibility index, has been determined for the Nevada/Utah area and the Texas/New Mexico area using maps of soil type and a table of erodibility index given in the EPA report, "Development of Emissions Factors for Fugitive Dust Sources," June 1974. The soils of the Nevada/Utah deployment area are mainly arid with clay and alkali or carbonate accumulation. However, the soil texture classification may range from predominately silt, as found in the playas, to all sand, as found in some sand dune areas. This range of soil textures presents a spread of erodibility index from 40 to 310. The end values of this spread are localized extremes and not truly representative of the system construction zones. A more appropriate range of values would be 86 to 235, covering texture classes which vary from silt loams to fine grained sands.

The types of soil found in Texas/New Mexico are semiarid loams, loamy sands, shallow clay loam deposits on bedrock, and arid soils with clay and alkali or carbonate accumulation. These soil types are representative of a texture erodibility index ranging from 35 to 150. Values ranging from 48 to 134 are assumed as appropriate for wind erosion calculations in the Texas/New Mexico DDA.

The surface roughness factor, K, denotes the resistance to wind erosion by ridges of given heights and spacings compared to a standard ridge height-spacing. The factor varies from 1.0 (no reduction) for a field with a smooth surface to a minimum of 0.5 for a field with the optimum ratio of ridge height to spacing.

The climatic factor, C, is calculated as a measure of wind velocity and surface moisture. Soil movement by wind varies directly as the cube of the wind velocity and inversely as the square of the soil surface moisture. The soil moisture varies directly with the amount of precipitation and inversely as the square of the temperature. The wind velocity data is obtained from weather records. PE indexes are used as an index of effective moisture of surface soil particles. The factor C is therefore based on average wind velocity and the PE index. The wind value is the corrected mean annual wind velocity for a standard height of 30 ft, and the PE is the yearly sum of monthly values determined from precipitation and temperature data. Garden City, Kansas is used as the standard base and the C factor for this

area is designated as 100 percent. The expression for finding the C factor for any other geographic location is:

$$C = 0.345 \frac{V^3}{(PE)^2}$$

Figure 4.1.2-1 presents climatic factors for the State of Nevada. The factors in the deployment area range from 300 percent in the southern portion of the state down to 20 percent in northcentral Nevada. Climatic factors for the Texas and New Mexico areas of interest range from 50 to 200 percent. To avoid extreme values, a range of C factors varying from 100 to 200 percent was considered as appropriate for wind erosion calculations in the Nevada/Utah DDA. A range of 100 to 150 percent was used for the Texas/New Mexico DDA.

The unsheltered field width, L, is the unsheltered distance across a field or strip in the direction of prevailing erosive winds. Soil flow across an eroding field is directly related to the width of the unprotected area. Soil flow increases across the field in the direction of the wind. When the prevailing wind is across a field or strip at an angle, the distance the prevailing wind travels can be obtained using Figure 4.1.2-2. The correlation between the width of a field and its rate of erosion is also affected by the soil erodibility of its surface: the more erodible the surface, the shorter the distance in which maximum soil movement is reached. This relationship between the unsheltered width of a field, L, its surface erodibility, IK, and its relative rate of soil erosion, L', is shown graphically in Figure 4.1.2-3.

If Figure 4.1.2-3 is used to obtain the L' factor, values for the variable I and K must already be known and an appropriate value for L must be determined. L can be determined for several different field widths depending on the type of eroding surface being examined. Disturbed land area around a shelter construction site is assumed to cover approximately 10 acres. DTN roads and cluster roads are assumed to have a disturbed surface width of 100 ft during construction. The 24 ft roadway surface of the DTNs is paved with bituminous surfacing during operation phases. The unsheltered distance factor, L', for a given surface in the prevailing wind direction varies continually. To assess an average effective distance factor, it may be assumed that in the long term, wind direction is equally distributed for all surfaces. Any error attributed to this assumption would be minimized by the more probable assumption that the surfaces are equally distributed in terms of orientation.

If it is assumed that the eroding surfaces are essentially flat surfaces with a maximum K value of 1.0, then the IK value would range from 86 to 235 for the Nevada/Utah area, and from 48 to 134 for the Texas/New Mexico area. The average values of L' for surfaces of specified erodibility IK, are shown in Tables 4.1.2-12 and 4.1.2-13.

The vegetative cover factor, V', is a measure of the type, quantity and orientation of residue on a field which will reduce soil wind erosion loss. The degree of reduction is related to the other surface erosion variables, and V' varies from 1.0 for no cover to 0 for heavy cover (no erosion).

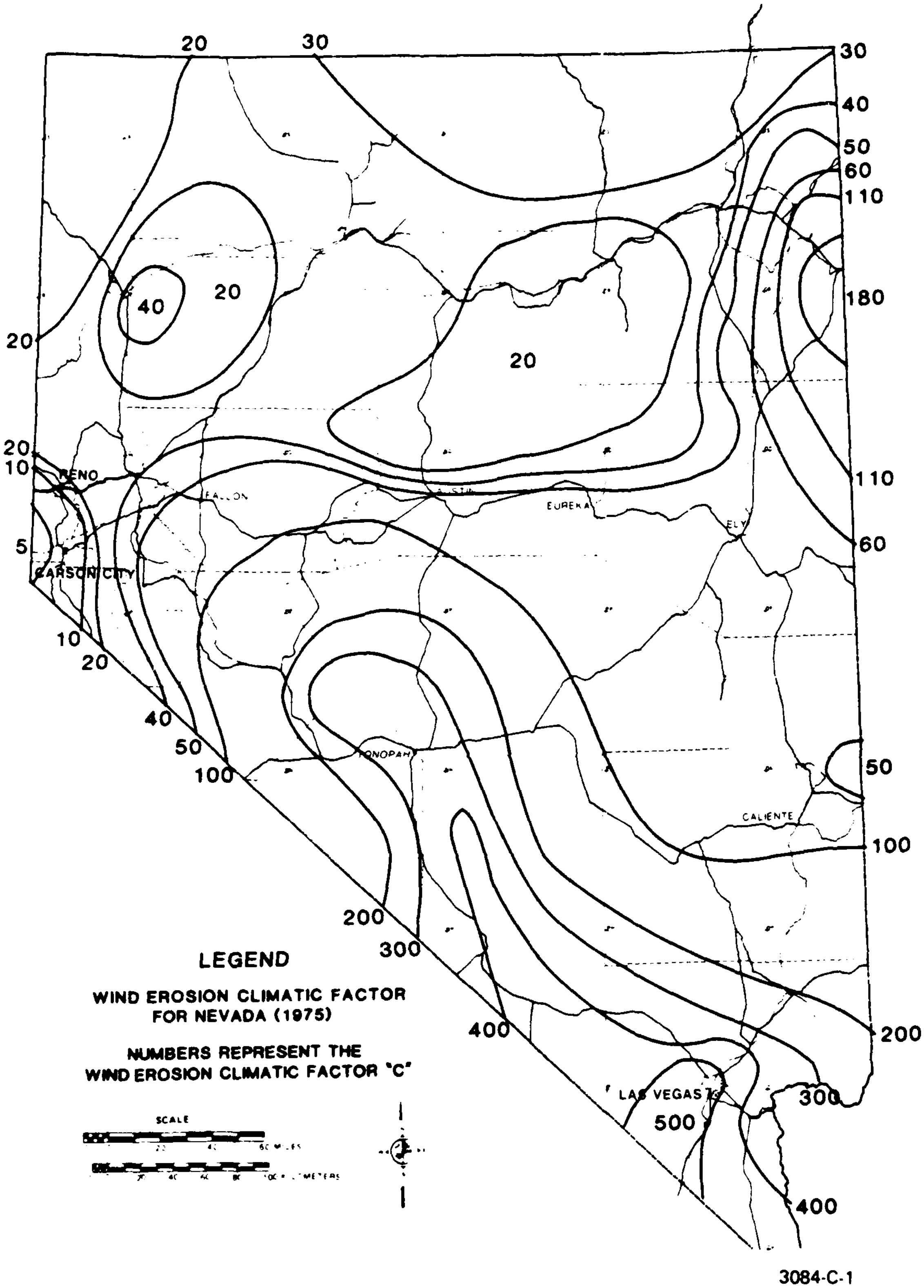

Figure 4.1.2-1. Wind erosion climatic factor in Nevada (1975).

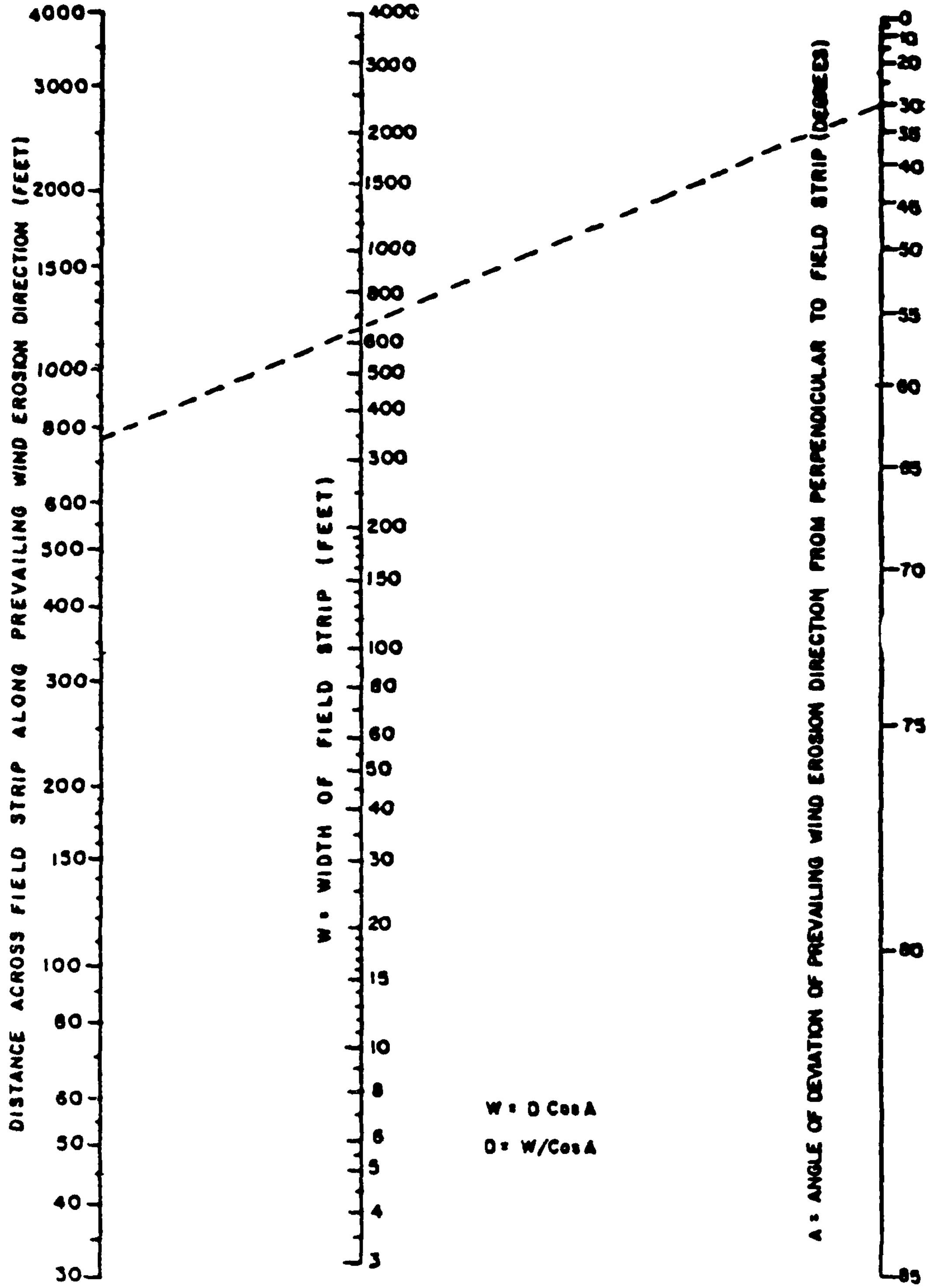

Figure 4.1.2-2. Alignment chart to determine: (1) Distance across field strip along the prevailing wind erosion direction from width of field strip and prevailing wind erosion direction, (2) width of field strip from prevailing wind erosion direction and distance across field strip along prevailing wind erosion direction.

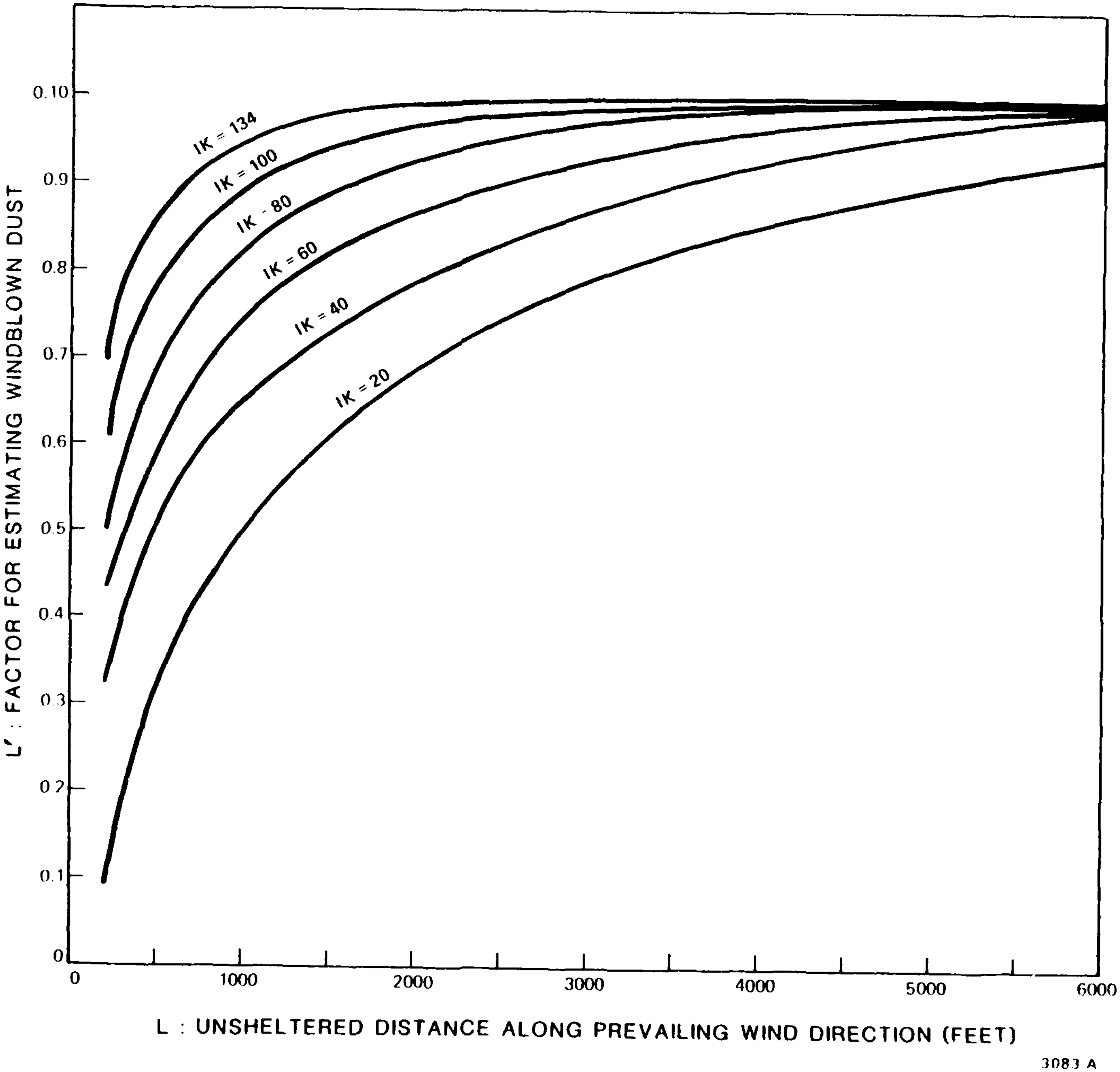

Figure 4.1.2-3. Effect of field length on relative emission rate.

Table 4.1.2-12. Unsheltered field width factor L' for 10-acre plot.

IK	L' at Different Prevailing Wind Directions $\theta = 90^{\circ}$	$\theta = 60^{\circ}$	$\theta = 30^{\circ}$	$\theta = 0^{\circ}$	Average L'
48	0.61	0.64	0.75	1.0	0.75
86	0.78	0.80	0.89	1.0	0.87
134	0.90	0.92	0.97	1.0	0.95
235	1.0	1.0	1.0	1.0	1.0

T3493/8-27-81

Table 4.1.2-13. Unsheltered field width factor L' for 100 ft. wide DTN or cluster road.

IK	L' at Different Prevailing Wind Directions $\theta = 90^\circ$	$\theta = 60^\circ$	$\theta = 30^\circ$	$\theta = 0^\circ$	Average L'
48	0.20	0.22	0.37	1.0	0.45
86	0.32	0.40	0.55	1.0	0.57
134	0.37	0.48	0.71	1.0	0.64
235	0.85	0.95	1.0	1.0	0.95

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Table 4.1.2-14 has been prepared to present the range of erosion rates possible in the construction areas of Nevada/Utah and Texas/New Mexico for various sizes and types of eroding surfaces. The low rates have been calculated using minimum potential values of I and C, and high rates using maximum values. Factor A is assumed to be equal to 0.025 for the disturbed soil areas, and 0.038 for gravel road surfaces. The eroding surfaces are assumed to be essentially flat and the K value is therefore set to 1.0. The vegetative cover factor will initially be 1.0 after construction and slowly decreases as revegetation takes place. Since specific information on the quantity and quality of revegetation is not available, V' is assumed to remain constant at 1.0.

Tables 4.1.2-15 and 4.1.2-16 indicate the potential range of total suspended particulates due to wind erosion which may occur in each construction zone of the Nevada/Utah and Texas/New Mexico DDAs.

Construction Emission Rates of Fugitive Dust--PAL Modeling (4.1.2.1.6)

In order to address the maximum near-field TSP impacts during construction the PAL model was run for typical construction areas. This section describes the calculation of dust emissions due to activities in the construction areas. This includes both dust emissions during construction of shelters, DTN roads, and cluster roads as well as road dust from vehicular traffic over shelter spur roads, cluster roads, and DTN roads.

Construction Areas

Assume an emission factor 1 & 1/2 times the AP-42 construction activity rate, since the AP-42 rate is for medium activity level and moderate silt content. M-X construction is assumed to occur at a high activity level in areas of varying silt content. A diagram of typical construction areas for which emission rates are calculated below is given (see Figure 4.1.2-4).

Construction Activity Fugitive Dust

Emission factor: 1.5 x 1.2 ton of particulates/acre month of activity = 1.8 tons/acre/mo. = 0.0006 g/sec-m^2

Size of construction areas:

1 shelter area = 10 acres
1 mi segment of DTN or cluster road = 5,280 ft x 100 ft = 12.1 acres

Emission rate for:

$$\text{Shelter} = \frac{1.8 \text{ ton}}{\text{acre-mo}} \times 10 \text{ acre} \times \frac{\text{mo.}}{22 \text{ day}} \times \frac{\text{day}}{8 \text{ hr}} \times \frac{\text{hr}}{3600 \text{ sec}} \times \frac{2000 \text{ lb}}{\text{ton}} \times \frac{453.5\text{g}}{\text{lb}}$$
$$= 25.7 \text{ g/sec.}$$

Similarly,

DTN or Cluster road = 31.2 g/sec

Table 4.1.2-14. Suspended particulate erosion rates, E_s, in tons/acre/year.

Erosion Area Type	Nevada/Utah $I = 86$, $C = 1.0$	Nevada/Utah $I = 235$, $C = 2.0$	Texas/New Mexico $I = 48$, $C = 1.0$	Texas/New Mexico $I = 134$, $C = 1.5$
Shelter area during construction and operation 10 acres	$L' = 0.87$ $E_s = 1.87$	$L' = 1.0$ $E_s = 11.75$	$L' = 0.75$ $E_s = 0.90$	$L' = 0.95$ $E_s = 4.77$
DTN and cluster roads[1] during construction 100 ft x 1 mile	$L' = 0.57$ $E_s = 1.38$	$L' = 0.95$ $E_s = 12.56$	$L' = 0.45$ $E_s = 0.61$	$L' = 0.64$ $E_s = 3.62$
DTN road[2] during operation 100 ft x 1 mile	$L' = 0.57$ $E_s = 1.23$	$L' = 0.95$ $E_s = 11.16$	$L' = 0.45$ $E_s = 0.54$	$L' = 0.64$ $E_s = 3.22$
Cluster road[1] during operation 100 ft x 1 mile	$L' = 0.57$ $E_s = 1.38$	$L' = 0.95$ $E_s = 12.56$	$L' = 0.45$ $E_s = 0.61$	$L' = 0.64$ $E_s = 3.62$
OB construction area 60 acres	$L' = 1.0$ $E_s = 2.15$	$L' = 1.0$ $E_s = 11.75$	$L' = 1.0$ $E_s = 1.20$	$L' = 1.0$ $E_s = 5.03$
OB construction area 100 acres	$L' = 1.0$ $E_s = 2.15$	$L' = 1.0$ $E_s = 11.75$	$L' = 1.0$ $E_s = 1.20$	$L' = 1.0$ $E_s = 5.03$

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[1] 24 feet of the 100 foot disturbance corridor is gravel roadway surface, remaining 76 feet is disturbed soil. 2.5% of wind eroded disturbed soils assumed to remain indefinitely suspended. 3.8% of wind eroded gravel particulates assumed to remain indefinitely suspended.

[2] 24 foot roadway surface area is paved with bituminous surfacing during operation phase.

Table 4.1.2-15. Total suspended particulates due to wind erosion in Nevada/Utah DDA (Page 1 of 2).

Zone No.	Erosion Area Type	Miles of Road or Number of Shelters	Area Disturbed During Construction (acres)	Area Disturbed During Operation (acres)	Suspended Particulates During Construction (tons/year)	Suspended Particulates During Operation (tons/year)
1	DTN	60	728	553	1,005 - 9,144	680 - 6,171
	Cluster road	341	4,133	4,133	5,704 - 51,910	5,704 - 51,910
	Shelter	253	2,530	2,530	4,731 - 29,728	4,731 - 29,728
			= 7,391	= 7,216	= 11,440 - 90,782	= 11,115 - 87,804
2	DTN	103	4133	949	1,724 - 15,687	1,167 - 10,591
	Cluster road	403	4,885	4,885	6,741 - 61,356	6,741 - 61,356
	Shelter	299	2,990	2,990	5,591 - 35,133	5,591 - 35,133
			= 9,124	= 8,824	= 14,056 - 112,176	= 13,499 - 107,080
3	DTN	94	1,140	867	1,573 - 14,318	1,066 - 9,676
	Cluster road	403	4,885	4,885	6,741 - 61,356	6,741 - 61,356
	Chelter	299	2,990	2,990	5,591 - 35,133	5,591 - 35,133
			= 9,015	= 8,742	= 13,905 - 110,807	= 3,398 - 106,165
4	DTN	65	788	599	1,087 - 9,897	737 - 6,685
	Cluster road	34	4,133	4,133	5,704 - 51,910	5704 - 51,910
	Shelter	253	2,530	2,530	4,731 - 29,728	4,731 - 29,728
			= 7,451	= 7,262	= 11,522 - 91,535	= 11,172 - 88,323
5	DTN	88	1,067	811	1,472 - 13,402	998 - 9,051
	Cluster road	279	3,383	3,383	4,669 - 42,490	4,669 - 42,490
	Shelter	207	2,070	2,070	3,871 - 24,322	3,871 - 24,322
			= 6,520	= 6,264	= 10,012 - 80,214	= 9,538 - 75,863
6	DTN	108	1,309	995	1,806 - 1,441	1,224 - 11,104
	Cluster road	403	4,885	4,885	6,741 - 61,355	6,741 - 61,355
	Shelter	253	2,530	2,530	4,731 - 29,728	4,731 - 29,728
			= 8,724	= 8,410	= 13,278 - 107,524	= 12,696 - 102,187
7	DTN	82	944	755	1,372 - 12,485	929 - 8,426
	Cluster road	310	3,758	3,758	5,186 - 47,200	5,186 - 47,200
	Shelter	230	2,300	2,300	4,301 - 27,025	4,301 - 27,025
			= 7,052	= 6,813	= 10,859 - 86,710	= 10,416 - 82,651
8	DTN	82	994	755	1,372 - 13,485	929 - 8,426
	Cluster road	310	3,758	3,758	5,186 - 47,200	5,186 - 47,200
	Shelter	230	2,300	2,300	4,201 - 27,025	4,301 - 27,025
			= 7,052	= 6,813	= 10,859 - 86,710	= 10,416 - 82,651
9	DTN	100	1,212	921	1,673 - 15,223	1,133 - 10,278
	Cluster road	527	6,388	6,388	8,815 - 80,233	8,815 - 80,233
	Shelter	391	3,910	3,910	7,312 - 45,942	7,312 - 45,942
			= 11,510	= 11,219	= 17,800 - 141,398	= 17,250 - 136,453

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Table 4.1.2-15. Total suspended particulates due to wind erosion in Nevada/Utah DDA (Page 2 of 2).

Zone No.	Erosion Area Type	Miles of Road or Number of Shelters	Area Disturbed During Construction (acres)	Area Disturbed During Operation (acres)	Suspended Particulates During Construction (tons/year)	Suspended Particulates During Operation (tons/year)
10	DTN	98	1,188	903	1,639 - 14,921	1,111 - 10,077
	Cluster road	434	5,260	5,260	7,259 - 66,066	7,259 - 66,066
	Shelter	368	3,680	3,680	6,882 - 43,240	6,882 - 43,240
			= 10,128	= 9,843	= 15,780 - 124,227	= 15,252 - 119,383
11	DTN	45	546	415	753 - 6,858	510 - 4,631
	Cluster road	248	3,006	3,006	4,148 - 37,755	4,148 - 37,755
	Shelter	184	1,840	1,840	3,441 - 21,620	3,441 - 21,620
			= 5,392	= 5,261	= 8,342 - 66,233	= 8,099 - 64,006
12	DTN	68	824	626	1,137 - 10,349	770 - 6,986
	Cluster road	248	3,006	3,006	4,148 - 37,755	4,148 - 37,755
	Shelter	184	1,840	1,840	3,441 - 21,620	3,441 - 21,620
			= 5,670	= 5,472	= 14,198 - 69,724	= 8,359 - 66,351
13	DTN	103	1,249	949	1,724 - 15,687	1,167 - 10,591
	Cluster road	589	7,140	7,140	9,853 - 89,678	9,853 - 89,678
	Shelter	437	4,370	4,370	8,172 - 51,348	8,172 - 51,34[illegible]
			= 12,759	= 12,459	= 32,208 - 156,713	= 19,192 - 151,617
14	DTN	74	897	682	1,238 - 11,266	839 - 7,611
	Cluster road	186	2,254	2,254	3,111 - 28,310	3,111 - 28,310
	Shelter	138	1,380	1,380	2,581 - 16,215	2,581 - 16,215
			= 4,531	= 4,316	= 6,930 - 62,721	= 6,531 - 52,136
15	DTN	72	873	664	1,205 - 10,965	817 - 7,410
	Cluster road	279	2,897	2,897	3,998 - 36,386	3,998 - 36,386
	Shelter	207	2,070	2,070	3,871 - 24,322	3,871 - 24,322
			= 5,840	= 5,631	= 9,074 - 86,378	= 8,686 - 68,118
16	DTN	56	679	516	937 - 8,528	635 - 5,759
	Cluster road	186	2,254	2,254	3,111 - 28,310	3,111 - 28,310
	Shelter	138	1,380	1,380	2,581 - 16,215	2,581 - 16,215
			= 4,212	= 4,150	= 6,629 - 53,053	= 6,327 - 50,284
17	DTN	80	969	736	1,337 - 12,171	905 - 8,214
	Cluster road	310	3,758	3,758	5,186 - 47,200	5,186 - 47,200
	Shelter	230	2,300	2,300	4,301 - 27,025	4,301 - 27,025
			= 7,027	= 6,794	= 10,824 - 86,396	= 10,392 - 82,439
18	DTN	80	970	737	1,339 - 12,183	907 - 8,225
	Cluster road	403	4,885	4,885	6,741 - 61,356	6,741 - 61,356
	Shelter	299	2,990	2,990	5,591 - 35,133	5,591 - 35,133
			= 8,645	= 8,612	= 13,671 - 108,672	= 13,239 - 104,714

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[1]Best case values assume a climatic factor, C', of 100 percent and soil erodability index, I', of 86 tons/acre/year. Worst case values assume C' = 200 percent and I' = 235 tons/acre/year. See Table 4.1.2-14 for erosion rates.

Table 4.1.2-16. Total suspended particulates due to wind erosion in Texas/New Mexico DDA (Page 1 of 2).

Zone No.	Erosion Area Type	Miles of Road or Number of Shelters	Area Disturbed During Construction (acres)	Area Disturbed During Operation (acres)	Suspended Particulates During Construction (tons/year)	Suspended Particulates During Operation (tons/year)
1	DTN	72	873	664	553 - 3,160	359 - 2,138
	Cluster road	446	5,406	5,406	3,298 - 19,570	3,298 - 19,570
	Shelter	345	3,450	3,450	3,105 - 16,456	3,105 - 16,456
			= 9,729	= 9,520	= 6,936 - 39,186	= 6,762 - 38,164
2	DTN	52	631	480	385 - 2,284	259 1,546
	Cluster road	416	5,042	5,042	3,076 - 18,252	3,076 - 18,252
	Shelter	322	3,220	3,220	2,898 - 15,359	2,898 - 15,359
3	DTN	141	1,709	1,299	1,042 - 6,187	701 - 4,183
	Cluster road	446	5,406	5,406	3,298 - 19,570	3,298 - 19,570
	Shelter	345	3,450	3,450	3,105 - 16,456	3,105 - 16,456
			= 10,565	= 10,155	= 7,445 - 42,213	= 7,104 - 40,209
4	DTN	97	1,176	894	717 - 4,257	483 - 2,879
	Cluster road	446	5,406	5,406	3,298 - 19,570	3,298 - 19,570
	Shelter	345	3,450	3,450	3,105 - 16,456	3,105 - 16,456
			= 10,032	= 9,750	= 7,120 - 40,283	= 6,886 - 38,905
5	DTN	169	2,048	1,556	1,249 - 7,414	840 - 5,010
	Cluster road	564	6,836	6,836	4,170 - 24,746	4,170 - 24,746
	Shelter	437	4,370	4,370	3,933 - 20,845	3,933 - 20,845
			= 13,254	= 12,762	= 9,352 - 53,005	= 8,943 - 50,601
6	DTN	94	1,139	866	695 - 4,123	468 - 2,789
	Cluster road	238	2,884	2,884	1,759 - 10,440	1,759 - 10,440
	Shelter	184	1,840	1,840	1,656 - 8,777	1,656 - 8,777
			= 5,863	= 5,590	= 4,110 - 23,340	= 3,883 - 22,006
7	DTN	64	776	590	473 - 2,809	319 - 1,900
	Cluster road	238	2,884	2,884	1,759 - 10,440	1,759 - 10,440
	Shelter	184	1,840	1,840	1,656 - 8,777	1,656 - 8,777
			= 5,500	= 5,314	= 3,888 - 22,026	= 2,734 -
8	DTN	52	630	479	384 - 2,280	259 - 1,542
	Cluster road	267	3,236	3,236	1,974 - 11,714	1,974 - 11,714
	Shelter	207	2,070	2,070	1,863 - 9,874	1,863 - 9,874
			= 5,936	= 5,785	= 4,221 - 23,868	= 4,096 - 23,130
9	DTN	30	364	277	169 - 1,318	150 - 892
	Cluster road	386	4,678	4,678	2,854 - 16,934	2,854 - 16,934
	Shelter	299	2,990	2,990	2,691 - 15,262	2,691 - 14,262
			= 8,032	= 7,945	= 5,714 - 32,514	= 5,695 - 32,088

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Table 4.1.2.1-16. Total suspended particulates due to wind erosion in Texas/New Mexico DDA (Page 2 of 2).

Zone No.	Erosion Area Type	Miles of Road or Number of Shelters	Area Disturbed During Construction (acres)	Area Disturbed During Operation (acres)	Suspended Particulates During Construction (tons/year)	Suspended Particulates During Operation (tons/year)
10	DTN	54	655	498	304 - 2371	269 - 1,604
	Cluster road	297	3,600	3,600	2,196 - 13,032	2,196 - 13,032
	Shelter	230	2,300	2,300	2,070 - 10,971	2,070 - 10,971
			= 6,555	= 6,398	= 4,570 - 26,374	= 4,535 - 25,607
11	DTN	155	1,879	1,428	1,146 - 6,802	771 - 4,598
	Cluster road	474	5,745	5,745	3,504 - 20,797	3,504 - 20,797
	Shelter	368	3,680	3,680	3,312 - 17,554	3,312 - 17,554
			= 11,304	= 10,853	= 7,962 - 45,153	= 7,587 - 42,949
12	DTN	71	861	654	525 - 3,117	353 - 2,106
	Cluster road	505	6,121	6,121	3,734 - 22,158	3,734 - 22,158
	Shelter	391	3,910	3,910	3,519 - 18,651	3,519 - 18,651
			= 10,892	= 10,685	= 7,778 - 43,926	= 7,606 - 42,915
13	DTN	94	1,139	866	695 - 4,123	468 - 2,789
	Cluster road	475	5,758	5,758	3,512 - 20,844	3,512 - 20,844
	Shelter	368	3,680	3,680	3,312 - 17,554	3,312 - 17,554
			= 10,577	= 10,304	= 7,519 - 42,521	= 7,292 - 41,187
14	DTN	49	594	451	362 - 2,150	244 - 1,452
	Cluster road	238	2,885	2,885	1,760 - 10,444	1,760 - 10,444
	Shelter	184	1,840	1,840	1,656 - 8,777	1,656 - 8,777
			= 5,319	= 5,176	= 3,778 - 21,371	= 3,660 - 20,673
15	DTN	67	812	617	495 - 2,939	333 - 1,987
	Cluster road	505	6,122	6,122	3,734 - 22,162	3,734 - 22,162
	Shelter	391	3,910	3,910	3,519 - 18,651	3,519 - 8,651
			= 10,844	= 10,649	= 7,748 - 43,752	= 7,586 - 42,800

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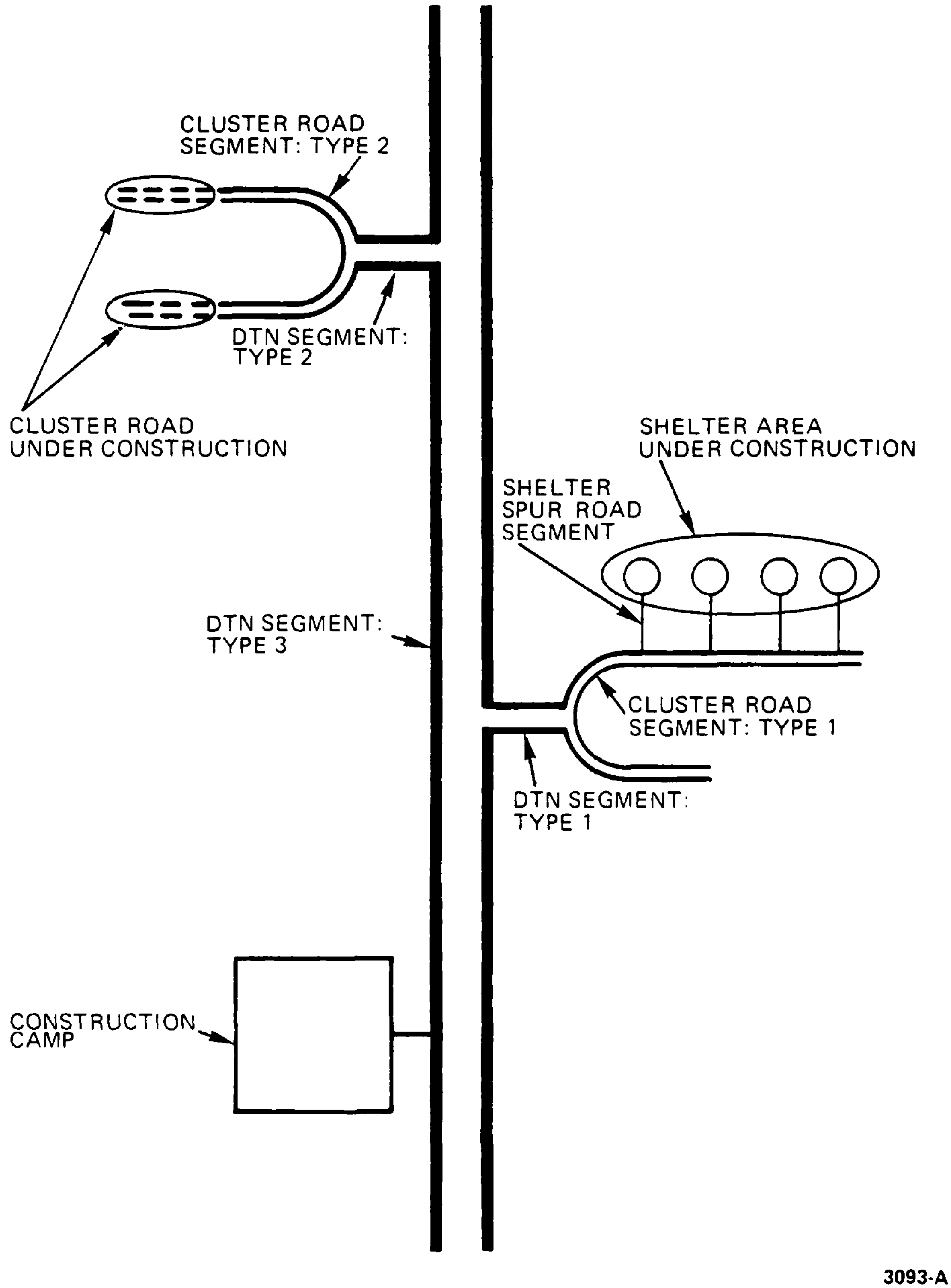

Figure 4.1.2-4. Diagram of road segments analyzed for PAL modeling.

Assumptions:

- o 22 construction days per month
- o 8 construction hours per construction day
- o 100 ft wide section disturbed for DTN or cluster road construction

Vehicular Road Dust on the Roads to Construction Areas

1 mi segment of shelter spur road

- o This is a road segment which connects the shelter construction area to the cluster road system
- o Peak daily vehicle flow over segment (based on equipment estimates for shelter construction)

Emission rates (g/sec, averaged over an 8-hour day)

1 32-ton truck trip per day	0.101
25 concrete truck trips per day	0.840
1 semi-truck trip per day	0.101
20-passenger vehicle trips per day	0.448
	1.490 ton/day = 46.9 g/sec
	= 0.0291 g/sec/m

Assumption:

- o One shelter area will handle 1 concrete truck approximately every 20 minutes

1-mile segment of cluster road (TYPE 1)

- o This is a completed cluster road segment which handles traffic flow from the shelter construction areas out to the main DTN network.

- o Peak daily vehicle flow over segment (based on equipment estimated for shelter construction)

Emission rates (g/sec, averaged over an 8-hour day)

Three 32-ton truck trips per day	0.303
100 concrete truck trips per day	3.360
Two semi-truck trips per day	0.202
100 passenger vehicle trips per day	2.240
	6.105 ton/day = 192.3 g/sec
	= 0.1195 g/sec/m

Number of concrete truck trips per day for shelter construction has been estimated from materials-use figures for a typical construction group as follows:

$$\frac{2.99 \times 10^5 \text{ cu yd of concrete}}{\text{shelter construction period}} \times \frac{\text{shelter construction period}}{282 \text{ days}} \times \frac{\text{concrete truck}}{12 \text{ cu yd}}$$

= 88 concrete truck trips/day (average rate)

Assume 4 shelters under simultaneous construction with 25 trips per day to each and a peak total flow of 100 trips/day:

1 mi segment of cluster road (TYPE 2)

- o This is a completed segment of cluster road which handles traffic from the active cluster road construction area to the main DTN network.

- o Peak daily vehicle flow over segment (based on equipment estimates for cluster road construction):

2 tank truck trips per day	0.179
200 off-road truck trips per day	8.960
1 semi-truck trip per day	0.101
75 passenger vehicle trips per day	1.680
	10.920 ton/day = 344.0 g/sec
	= 0.2138 g/sec/m

(Emission rate is based on a worst-case vehicle emission factor of 0.0112 ton/vehicle mile. For suspended dust only multiply all numbers by 0.62.)

- o Number of off-road truck trips per day for cluster road construction has been estimated from materials-use figures for a typical construction group as follows:

$$\frac{3.29 \times 10^6 \text{ cu yd of aggregate}}{\text{construction period cluster}} \times \frac{\text{cluster construction period}}{216 \text{ days}} \times \frac{\text{off-road truck}}{40 \text{ cu yd}}$$

= 380 off-road truck trips/day (average rate)

- o Assume that there are two separate cluster road construction areas operating simultaneously with a peak daily flow of 200 trips/day in each.

1 mi segment of DTN road (TYPE 1)

- o This is a spur segment of DTN road which handles traffic from the shelter construction areas to the main DTN network (could also be the main network segment with no other traffic).

- o Emission rates and assumptions are same as for "cluster road segment - TYPE 1" = 192.3 g/sec.

1 mi segment of DTN road (TYPE 2)

- o This is a spur segment of DTN road which handles traffic from the cluster road construction areas to the main DTN network (could also be a main network segment with no other traffic).

- o Traffic flow on this segment is essentially a doubling of "cluster road segment - TYPE 2" traffic, except that tank truck trips and semi-truck trips are limited by the vehicle allocation numbers.

- o Peak daily flow over DTN segment (TYPE 3)

Three 32-ton truck trips per day	0.303	
3 tank truck trips per day	0.269	
4 semi-truck trips per day	0.404	
100 concrete truck trips per day	3.360	
400 off-road truck trips per day	17.920	
500 passenger vehicle trips per day	11.200	
	33.456	ton/day = 1054.0 g/sec
		= 0.6551 g/sec/m

(Emission rate is based on a worst-case vehicle emission factor of 0.0112 ton/vehicle mile. For suspended dust only multiply all numbers by 0.62.)

NOTE: Peak daily flows for all previous line source segments do not include watering vehicles. All emission rates for road segments are based on a worst-case vehicle emission factor of 0.0112 ton/vehicle/mi (see Section 4.1.2.1.1). No mitigations have been applied. Addition of watering trucks and other personnel vehicles to DTN segment flows could increase vehicle numbers and emission rates by a factor of 6. Application of mitigation measures could reduce emission rates on DTNs by a factor of 10.

Construction Emission Rates of Fugitive Dust - IMPACT Modeling (4.1.2.1.7)

In order to use the IMPACT model to estimate the air quality impacts during construction, inventories of construction-related fugitive dust sources were assembled. These inventories were based on the calculations appearing in Sections 4.1.2.1.1 through 4.1.2.1.6. An example inventory, for Dry Lake-Delamar Valley appears in Table 4.1.2-17. This table indicates the emission rate for each construction activity or source using best-case and probable-case assumptions. Probable-case emission rates were used as model input for the IMPACT model runs. Results of the IMPACT modeling appear in Section 5.1.5.

Combustion-Related Vehicular Emissions (4.1.2.2)

Motor vehicle emissions from M-X construction activities were examined as potential sources of air quality degradation. The pollutants of concern emitted by combustion processes are particulates, carbon monoxide, nitrogen oxides, sulfur dioxide, and hydrocarbons. In addition, ozone and other oxidant pollutants are formed when nitrogen oxides and hydrocarbons react photochemically in the presence of sunlight.

The major source of the vehicle emissions associated with the construction activities is the operation of heavy-duty diesel-powered vehicles. Emission factors for various types of heavy-duty diesel-powered construction equipment have been determined by the EPA (1976) and are listed in Table 4.1.2-18. The factors listed for each pollutant type are given in units of tons of pollutants emitted per hour of vehicle operation. A normal construction day is assumed to be eight hours. The

Table 4.1.2-17. Summary of construction-related dust emission rates in a representative deployment area valley with a construction camp: the Dry Lake-Delamar Valley[1] (Page 1 of 2).

Activity or Source	Worst Case Rate (tons/day)[2]	Probable Case Rate (tons/day)[2]
DTN construction road dust	172.6[3]	48.9[4]
Cluster road construction road dust	284.0[3]	80.4[4]
Shelter construction road dust	94.5[3]	26.7[4]
DTN construction activities	1.8[5]	1.35[6]
Cluster road construction activities	23.6[5]	17.7[6]
Shelter construction activities	7.4[5]	5.6[6]
Sand and gravel processing for DTN road base	0.3[7]	0.3[7]
Sand and gravel processing for cluster road base	0.8[7]	0.8[7]
Sand and gravel processing for shelters	0.05[7]	0.05[7]
Sand and gravel processing for DTN bituminous surfacing	8.8[7,8]	8.8[7,8]
Stone quarrying and processing for DTN road base	1.1[9]	0.28[10]
Stone quarrying and processing for cluster road base	3.2[9]	0.8[10]
Stone quarrying and processing for shelters	0.82[9]	0.21[10]
Stone quarrying and processing for DTN bituminous surfacing	35.2[8,9]	8.8[8,10]
Asphaltic concrete plant	7,918.0[8,11]	29.8[8,12]
Concrete batching plant	0.1[13]	0.01[14]
Aggregate storage piles for DTN, cluster road, and shelter material	9.23[15]	5.13[16]
Wind erosion from disturbed surfaces and roads	168.0[17,18]	168.0[17,18]

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[1]Worst case emissions indicate no mitigation measures applied. The probable case emission rates represent the emission rate possible, according to published emission factors, using all reasonable mitigation.

[2]Rates are reported as average values over the lifetime of the construction activity.

[3]Emission factor = 22.4 lb. of dust per vehicle per mile traveled (factor calculation assumes 20 percent silt content in road material, 45 mph average speed, and 29 construction days per year with 0.01 in. or more rainfall).

[4]Emission factor = 12.7 lb. of dust per vehicle per mile traveled (factor calculation assumes 12 percent silt content in road material, 45 mph average speed, and 47 construction days per year with 0.01 in. or more rainfall). Watering used as control measure and assumed to be 50 percent effective.

Table 4.1.2-17. Summary of construction-related dust emission rates in a representative deployment area valley with a construction camp: the Dry Lake-Delamar Valley[1] (Page 2 of 2).

[5]Emission rate = 1.8 tons of dust per acre of construction per month of activity. No control measures.

[6]Emission rate = 1.35 tons of dust per acre of construction per month of activity. Watering used as control measure and assumed to be 25 percent effective.

[7]Emission factor = 0.1 lb. of dust per ton of material processed.

[8]Value is total emissions of dust in tons. (Rate unknown because time period for process unspecified.)

[9]Emission factor = 1.6 lb. of dust per ton of material produced. No control measures.

[10]Emission factor = 0.4 lb. of dust per ton of material produced. Cyclone collectors and fabric filters can provide 75 to 99 percent control. 75 percent control assumed in this example.

[11]Emission factor = 45.0 lb. of dust per ton of material processed. No control measures. (Rate unknown because time period for process unspecified.)

[12]Emission factor = 0.04 lb. of dust per ton of material processed. Orifice-type scrubber used as best control available. (Rate unknown because time period for process unspecified.)

[13]Emission factor = 0.2 lb. of dust per cubic yard of material produced. No control measures.

[14]Emission factor = 0.02 lb. of dust per cubic yard of material produced. Enclosures, filters, and watering used as control measures.

[15]Emission factor = 615.4 lb. of dust per acre of storage per day. No control measures.

[16]Emission factor = 342.0 lb. of dust per acre of storage per day. Water applied to storage yard traffic areas and chemical stabilizers used on storage piles as control measures.

[17]Emission factor = 6.0 tons of dust per acre of roadway per year (DTN and cluster roads).

[18]Emission factor = 9.1 tons of dust per acre of native soil disturbed per year (shelter areas).

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Table 4.1.2-18. Emission factors for diesel-powered construction equipment. From DPA (1976).

TYPE OF CONSTRUCTION EQUIPMENT	POLLUTANT EMISSION FACTOR				
	CO TONS/HR x 10^{-3}	EXHAUST HYDROCARBONS TONS/HR x 10^{-3}	NO_x TONS/HR x 10^{-3}	SO_x TONS/HR x 10^{-3}	PARTICULATES TONS/HR x 10^{-3}
Tracklaying Tractor	[illegible]	5.5	[illegible]	[illegible]	[illegible]
Wheeled Tractor	[illegible]	7.4	[illegible]	4.5	6.8
Wheeled Dozer	[illegible]	[illegible]	252.5	17.4	[illegible]
Scraper	[illegible]	[illegible]	[illegible]	23.1	[illegible]
Motor Grader	[illegible]	[illegible]	52.5	4.3	3.0
Wheeled Loader	[illegible]	9.3	120.0	9.1	3.6
Tracklaying Loader	8.0	[illegible]	29.2	3.8	[illegible]
Off-Highway Truck	[illegible]	21.8	381.5	22.7	12.8
Roller	[illegible]	2.7	52.0	3.3	[illegible]
Miscellaneous	[illegible]	7.8	113.5	7.1	[illegible]

total number of construction days as well as the number and types of vehicles to be used can be determined from the construction schedule (Table 4.1.1-1) and equipment usage lists (Tables 4.1.1-2 through 4.1.1-4). The construction schedule presented is for full deployment in Nevada/Utah with the initial construction effort commencing in group no. 11. Maximum daily equipment use is assumed to be similar for any given group area regardless of the system deployment alternative. Daily emission rates for each pollutant and vehicle type can be determined by multiplying the emission factor (from Tables 4.1.2-18 and 4.1.2-19) by the number of vehicles and by the hours of operation. The daily emission rate is then multiplied by the total number of construction days to yield the total amount of emissions (Table 4.1.2-20 through 4.1.2-34).

The emissions from other vehicles used to support the construction activities (semi-trailers, carry-alls, water trucks, etc.) can be calculated in the same manner using the emission factors listed in Table 4.1.2-19. The factors listed are mean value emission rates based on Federal Testing Procedure (FTP) conditions. The FTP conditions under which the light-duty vehicles were tested are as follows:

1. Ambient temperature = 75°F average (68°F - 86°F)
2. Absolute humidity = 75 grains
3. Average speed = 20 mph, 18 percent idle operation
4. Average cold operation = 21 percent
5. Average hot-start operation = 27 percent
6. Average stabilized operation = 52 percent
7. Air-conditioning not in use
8. Vehicle contains driver only
9. Vehicle is not pulling a trailer
10. Vehicles receive typical in-use maintenance.

The testing for heavy-duty vehicles differed only in that 100 percent stabilized operation was used, and normal vehicle loading was allowed for.

For scenarios which vary from the FTP conditions, correction factors may be applied. Corrections are best handled by use of a computerized model, MOBILE 1, available from the U.S. Environmental Protection Agency. For present purposes, however, the mean value emission rates were considered as adequate. The rate for a particular pollutant and vehicle type was multiplied by the number of vehicles and by the miles per day of travel to determine a daily emission rate. The daily rate could then be multiplied by the number of construction days to determine total emissions. Summary tables of the emission rates are presented in Tables 4.1.2-35 through 4.1.2-39.

Power Generator Emissions (Gaseous and Particulate) (4.1.2.3)

Emissions from the power generators located at concrete batch plants, asphaltic concrete plants, and sand and gravel processing plants are included in Tables 4.1.2-40 through 4.1.2-45. Power generator emissions are calculated by considering the fuel needed to process or produce the required materials at each facility. Fuel use is multiplied by emission factors for each pollutant (Table 4.1.2-46) to obtain the total emission value. Daily emission rates are calculated by dividing the total emission value by the construction days. Power

Table 4.1.2-19. Emission factors[a] for automobiles and trucks-based on 1975 Federal Testing Procedures (FTP) standard conditions. EPA (1976).

VEHICLE TYPE	POLLUTANT EMISSION FACTOR				
	CO (TONS/MI x 10^{-5})	HYDROCARBONS[b] (TONS/MI x 10^{-5})	NO_x (TONS/MI x 10^{-5})	SO_x (TONS/MI x 10^{-5})	PARTICULATES[c] (TONS/MI x 10^{-5})
Gasoline-powered, Light-Duty Vehicle (Automobile)	3.54	0.31	0.25	0.01	0.06
Gasoline-powered, Light-Duty Truck <6000 lbs.	4.43	0.39	0.25	0.02	0.06
Gasoline-powered, Light-Duty Truck 6001-8500 lbs.	4.47	0.39	0.25	0.02	0.06
Gasoline-powered, Heavy-Duty Vehicle (Buses and Trucks)	24.94	1.12	1.00	0.04	0.14 + 0.02 (W/4)
Diesel-powered, Heavy-Duty Vehicle (Buses and Trucks)	2.98	0.50	2.19	0.31	0.14 + 0.02 (W/4)

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[a]Emission factors are for 1982 calendar year assuming 1979 vehicle models. Emission factors for 1979 models have been projected from test data prior to 1976. Not valid for high altitude areas.

[b]Includes exhaust, evaporative, and crankcase hydrocarbons.

[c]Includes both exhaust and tire wear. An adjustment is made for trucks with more than 4 tires. W equals the number of tires.

Table 4.1.2-20. TSP motor vehicle emissions associated with DTN construction.

1 SEGMENT NUMBER	2 VEHICLE TYPE*	3 NUMBER OF VEHICLES	4 DISTANCE TRAVELED mi/day (km/day) OR OPERATING TIME hr/day	5 EMISSION FACTOR X 10⁻⁵ tons/mi (tonnes/km) OR tons/hr (tonnes/hr)	6 NUMBER OF CONSTRUCTION DAYS	7 EMISSIONS PER DAY X 10⁻¹ tons (tonnes) (3.) x (4.) x (5.)	8 TOTAL EMISSIONS tons (tonnes) (3.) x (4.) x (5.) x (6.)
1	Spray truck	2	20 (12)	0.23 (0.34)	586	0.01 (0.01)	0.1 (0.1)
	Semi	1	500 (311)	0.24 (0.35)	586	0.12 (0.11)	0.7 (0.6)
	Tank truck	3	500 (311)	0.23 (0.34)	586	0.35 (0.32)	2.0 (1.8)
	Water Truck	170	160 (99)	0.23 (0.34)	586	6.26 (5.68)	36.7 (33.3)
	Carry all	3	20 (12)	0.03 (0.04)	586	0.00 (0.00)	0.0 (0.0)
	30-ton truck	32	240 (149)	0.24 (0.35)	586	1.84 (1.67)	10.8 (9.8)
	Off road truck	39	8	12.8 (11.6)	586	3.99 (3.62)	23.4 (21.2)
	D-5 dozer	17	8	8.25 (7.48)	586	1.12 (1.02)	6.6 (6.0)
	12-G grader	44	8	3.05 (2.77)	586	1.07 (0.97)	6.3 (5.7)
	Backhoe	3	8	8.60 (7.80)	586	0.21 (0.19)	1.2 (1.1)
	641-B scraper	23	8	20.30 (18.41)	586	3.74 (3.39)	21.9 (19.9)
	Compactor	50	8	2.50 (2.27)	586	1.00 (0.91)	5.9 (5.4)
	Pipelayer	3	8	6.95 (6.30)	586	0.17 (0.15)	1.0 (0.9)
	Paver	4	8	2.50 (2.27)	586	0.08 (0.07)	0.5 (0.5)
	Roller	8	8	2.50 (2.27)	586	0.16 (0.15)	0.9 (0.8)
Sub-Total		402				20.12 (18.25)	118.0 (107.0)
2	Spray truck	2	20 (12)	0.23 (0.34)	564	0.01 (0.01)	0.1 (0.1)
	Semi	1	500 (311)	0.24 (0.35)	564	0.12 (0.11)	0.7 (0.6)
	Tank truck	3	500 (311)	0.23 (0.34)	564	0.35 (0.32)	1.9 (1.7)
	Water truck	130	160 (99)	0.23 (0.34)	564	4.78 (4.34)	27.0 (24.5)
	Carry all	3	20 (12)	0.03 (0.04)	564	0.00 (0.00)	0.0 (0.0)
	30-ton truck	24	240 (149)	0.24 (0.35)	564	1.38 (1.25)	7.8 (7.1)
	Off road truck	31	8	12.80 (11.60	564	3.17 (2.88)	17.9 (16.2)
	D-5 dozer	13	8	8.25 (7.48)	564	0.86 (0.78)	4.8 (4.4)
	12-G grader	34	8	3.05 (2.77)	564	0.83 (0.75)	4.7 (4.3)
	Backhoe	2	8	8.60 (7.80)	564	0.14 (0.13)	0.8 (0.7)
	641-B scraper	18	8	20.30 (18.41)	564	2.92 (2.65)	16.5 (15.0)
	Compactor	38	8	2.50 (2.27)	564	0.76 (0.69)	4.3 (3.9)
	Pipelayer	2	8	6.95 (6.30)	564	0.11 (0.10)	0.6 (0.5)
	Paver	3	8	2.50 (2.27)	564	0.06 (0.05)	0.3 (0.3)
	Roller	6	8	2.50 (2.27)	564	0.12 (0.11)	0.7 (0.6)
Sub-Total		310				15.61 (14.16)	88.1 (79.9)
3	Spray truck	2	20 (12)	0.23 (0.34)	586	0.01 (0.01)	0.1 (0.1)
	Semi	1	500 (311)	0.24 (0.35	586	0.12 (0.11)	0.7 (0.6)
	Tank truck	3	500 (311)	0.23 (0.34)	586	0.35 (0.32)	2.0 (1.8)
	Water truck	149	160 (99)	0.23 (0.34)	586	1.80 (1.63)	10.6 (9.6)
	Carry all	3	20 (12)	0.03 (0.04)	586	0.00 (0.00)	0.0 (0.0)
	30-ton truck	27	240 (149)	0.24 (0.35)	586	1.56 (1.41)	9.1 (8.3)
	Off-road truck	34	8	12.80 (11.60)	586	3.49 (3.16)	20.4 (18.5)
	D-5 dozer	15	8	8.25 (7.48)	586	0.99 (0.90)	5.8 (5.3)
	12-G grader	39	8	3.05 (2.77)	586	0.95 (0.86)	5.6 (5.1)
	Backhoe	2	8	8.60 (7.80)	586	0.14 (0.13)	0.8 (0.7)
	641-B scraper	20	8	20.30 (18.41)	586	3.25 (2.95)	19.0 (17.2)
	Compactor	44	8	2.50 (2.27)	586	0.88 (0.80)	5.2 (4.7
	Pipelayer	2	8	6.95 (6.30)	586	0.11 (0.10)	0.7 (0.6
	Paver	3	8	2.50 (2.27)	586	0.06 (0.05)	0.4 (0.4
	Roller	7	8	2.50 (2.27)	586	0.14 (0.13)	0.8 (0.7
Sub-Total		351				13.84 (12.55)	81.2 (73.6
4	Spray truck	2	20 (12)	0.23 (0.34)	500	0.01 (0.01)	0.0 (0.0)
	Semi	1	500 (311)	0.24 (0.35)	500	0.12 (0.11)	0.6 (0.5)
	Tank truck	3	500 (311)	0.23 (0.34)	500	0.35 (0.32)	1.7 (1.5)
	Water truck	158	160 (99	0.23 (0.34)	500	5.61 (5.27)	29.1 (26.4)
	Carry all	3	20 (12)	0.03 (0.04)	50	0.00 (0.00)	0.0 (0.0)
	30-ton truck	29	240 (149)	0.24 (0.35)	500	1.67 (1.51	8.4 (7.6
	Off-road truck	36	8	12.8 (11.60)	500	3.69 (3.35)	18.4 (16.7)
	D-5 dozer	16	8	8.25 (7.48	500	1.06 (0.96)	5.3 (4.8)
	12-G grader	41	8	3.05 (2.77)	500	1.00 (0.91)	5.0 (4.5)
	Backhoe	3	8	8.60 (7.80)	500	0.21 (0.19)	1.0 (0.9
	641-B scraper	21	8	20.3 (18.41)	500	3.41 (3.09)	17.1 (15.5)
	Compactor	46	8	2.50 (2.27	500	0.92 (0.83)	4.6 (4.2)
	Pipelayer	3	8	6.95 (6.30	500	0.17 (0.15)	0.8 (0.7
	Paver	4	8	2.50 (2.27	500	0.08 (0.07)	0.4 (0.4)
	Roller	7	8	2.50 (2.27	500	0.14 (0.13)	0.7 (0.6)
Sub-Total		373				18.64 (16.91)	93.1 (84.4
Total		1,436				68.21 (61.87)	380.4 (345.0

*All vehicles are diesel powered except carry-alls.

Table 4.1.2-21. TSP motor vehicle emissions associated with cluster road construction.

1	2	3	4	5	6	7	8
SEGMENT NUMBER	VEHICLE TYPE*	NUMBER OF VEHICLES	DISTANCE TRAVELED mi/day (km/day) OR OPERATING TIME hr/day	EMISSION FACTOR x $10^{-[illegible]}$ tons/mi (tonnes/km) OR tons/hr (tonnes/hr)	NUMBER OF CONSTRUCTION DAYS	EMISSIONS PER DAY x 10^{-2} tons (tonnes) (3.) x (4.) x (5.)	TOTAL EMISSIONS tons (tonnes) (3.) x (4.) x (5.) x (6.)
1	Semi	2	500 (311)	0.24 (0.35)	1151	0.24 (0.22)	2.8 (2.5)
	Tank truck	3	500 (311)	0.23 (0.34)	1151	0.35 (0.32)	4.0 (3.6)
	Water truck	235	160 (99)	0.23 (0.34)	1151	8.57 (7.77)	98.7 (89.5)
	Carry all	6	20 (12)	0.03 (0.04)	1151	0.00 (0.00)	0.0 (0.0)
	Off-road truck		8	12.6 (11.6)	1151	7.46 (6.78)	86.0 (78.0)
	641-B scraper	6	8	20.3 (18.41)	1151	1.30 (1.18)	15.0 (13.6)
	D-5 dozer	13	8	8.25 (7.48)	1151	0.86 (0.78)	9.9 (9.0)
	12-G grader	40	8	3.05 (2.77)	1151	0.96 (0.89)	11.2 (10.2)
	Backhoe	5	8	8.60 (7.80)	1151	0.34 (0.31)	4.0 (3.6)
	Spreader	1	8	2.50 (2.27)	1151	0.02 (0.02)	0.2 (0.2)
	Compactor	61	8	2.50 (2.27)	1151	1.22 (1.11)	14.[illegible] (12.7)
	Pipelayer	5	8	6.95 (6.30)	1151	0.28 (0.25)	3.2 (2.9)
Sub-Total		450				21.64 (19.63)	249.0 (225.8)
2	Semi	1	500 (311)	0.24 (0.35)	934	0.12 (0.11)	1.1 (1.0)
	Tank truck	3	500 (311)	0.23 (0.34)	934	0.35 (0.32)	3.2 (2.9)
	Water truck	179	160 (99)	0.23 (0.34)	934	6.59 (5.98)	61.5 (55.8)
	Carry all	4	20 (12)	0.03 (0.04)	934	0.00 (0.00)	0.0 (0.0)
	Off-road truck	56	8	12.80 (11.60)	934	5.73 (5.20)	53.6 (48.6)
	641-B scraper	7	8	20.30 (18.41)	934	1.14 (1.03)	10.6 (9.6)
	D-5 dozer	10	8	8.25 (7.48)	934	0.66 (0.60)	6.2 (5.6)
	12-G grader	30	8	8.60 (7.80)	934	2.06 (1.87)	19.3 (17.5)
	Backhoe	4	8	2.50 (2.27)	934	0.08 (0.07)	0.7 (0.6)
	Spreader	1	8	2.50 (2.27)	934	0.02 (0.02)	0.2 (0.2)
	Compactor	47	8	2.50 (2.27)	934	0.94 (0.85)	8.8 (8.0)
	Pipelayer	4	8	6.95 (6.30)	934	0.22 (0.20)	2.1 (1.9)
Sub-Total		346				17.91 (16.24)	167.3 (151.7)
3	Semi	2	500 (311)	0.24 (0.35)	826	0.24 (0.22)	2.0 (1.8)
	Tank truck	3	500 (311)	0.23 (0.34)	826	0.35 (0.32)	2.9 (2.6)
	Water truck	204	160 (99)	0.23 (0.34)	826	7.51 (6.81)	62.0 (56.2)
	Carry-all	5	20 (12)	0.03 (0.04)	826	0.00 (0.00)	0.0 (0.0)
	Off-road truck	64	8	12.80 (11.60)	826	6.55 (5.94)	54.1 (49.1)
	641-B scraper	7	8	20.30 (18.41)	826	1.14 (1.03)	9.4 (8.5)
	D-5 dozer	12	8	8.25 (7.48)	826	0.79 (0.71)	6.5 (5.9)
	12-G grader	35	8	8.60 (7.80)	826	2.41 (2.19)	19.9 (18.0)
	Backhoe	4	8	2.50 (2.27)	826	0.08 (0.07)	0.7 (0.6)
	Spreader	1	8	2.50 (2.27)	826	0.02 (0.02)	0.2 (0.2)
	Compactor	53	8	2.50 (2.27)	826	1.06 (0.96)	8.8 (8.0)
	Pipelayer	4	8	6.95 (6.30)	826	0.22 (0.20)	1.8 (1.6)
Sub-Total		394				20.37 (18.48)	168.3 (152.6)
4	Semi	2	500 (311)	0.24 (0.35)	956	0.24 (0.22)	2.3 (2.1)
	Tank truck	3	500 (311)	0.23 (0.34)	956	0.35 (0.32)	3.3 (3.0)
	Water truck	216	160 (99)	0.23 (0.34)	956	7.95 (6.81)	76.0 (66.9)
	Carry-all	5	20 (12)	0.03 (0.04)	956	0.00 (0.00)	0.0 (0.0)
	Off-road truck	67	8	12.80 (11.60)	956	6.86 (6.22)	65.6 (59.5)
	641-B scraper	8	8	20.30 (18.41)	956	1.30 (1.18)	12.4 (11.2)
	D-5 dozer	11	8	8.25 (7.48)	956	0.86 (0.78)	8.2 (7.4)
	12-G grader	37	8	8.60 (7.80)	956	2.55 (2.31)	24.3 (22.0)
	Backhoe	4	8	2.50 (2.27)	956	0.08 (0.07)	0.8 (0.7)
	Spreader	1	8	2.50 (2.27)	956	0.02 (0.02)	0.2 (0.2)
	Compactor	57	8	2.50 (2.27)	956	1.14 (1.03)	10.9 (9.9)
	Pipelayer	4	8	6.95 (6.30)	956	0.22 (0.20)	2.1 (1.9)
Sub-Total		417				21.57 (19.56)	206.1 (186.9)
Total		1,6[illegible]7				81.49 (73.91)	79[illegible].7 (717.2)

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*All vehicles are diesel powered except carry-alls.

Table 4.1.2-22. TSP motor vehicle emissions associated with shelter construction.

1	2	3	4	5	6	7	8
SEGMENT NUMBER	VEHICLE TYPE[a]	NUMBER OF VEHICLES	DISTANCE TRAVELED mi/day (km/day) OR OPERATING TIME hr/day	EMISSION FACTOR X 10^{-5} tons/mi (tonnes/km) OR tons/hr (tonnes/hr)	NUMBER OF CONSTRUCTION DAYS	EMISSIONS PER DAY X 10^{-2} tons (tonnes) (3.) x (4.) x (5.)	TOTAL EMISSIONS tons (tonnes) (3.)x(4.)x(5.)x(6.)
1	32-ton truck	3	500 (311)	0.24 (0.35)	1239	0.36 (0.33)	4.5 (4.1)
	Concrete truck	50	150 (93)	0.18 (0.26)	1239	1.35 (1.22)	16.7 (15.1)
	Semi	2	500 (311)	0.24 (0.35)	1239	0.24 (0.22)	3.0 (2.7)
	Water truck	224	160 (99)	0.23 (0.34)	1239	8.24 (7.47)	102.1 (92.6)
	Carry-all	3	20 (12)	0.03 (0.04)	1239	0.00 (0.00)	0.0 (0.0)
	Flatbed truck	12	20 (12)	0.23 (0.34)	1239	0.06 (0.05)	0.7 (0.6)
	D-5 dozer	10	8	8.25 (7.48)	1239	0.66 (0.60)	8.2 (7.4)
	Compactor	3	8	2.50 (2.27)	1239	0.06 (0.05)	0.7 (0.6)
	D-9 with ripper	4	8	3.05 (2.77)	1239	0.06 (0.09)	1.2 (1.1)
	641-B scraper	6	8	20.30 (18.41)	1239	0.97 (0.88)	12.1 (11.0)
	12-G grader	2	8	3.05 (2.77)	1239	0.05 (0.05)	0.6 (0.5)
Sub-Total		319				12.09 (10.97)	149.8 (135.9)
2	32-ton truck	3	500 (311)	0.24 (0.35)	1173	0.36 (0.33)	4.2 (3.8)
	Concrete truck	39	150 (93)	0.18 (0.26)	1173	1.05 (0.95)	12.4 (11.2)
	Semi	1	500 (311)	0.24 (0.35)	1173	0.12 (0.11)	1.4 (1.3)
	Water truck	171	160 (99)	0.23 (0.34)	1173	6.29 (5.71)	73.8 (66.9)
	Carry-all	2	20 (12)	0.03 (0.04)	1173	0.00 (0.00)	0.0 (0.0)
	Flatbed truck	10	20 (12)	0.23 (0.34)	1173	0.05 (0.05)	0.5 (0.5)
	D-5 dozer	7	8	8.25 (7.48)	1173	0.46 (0.42)	5.4 (4.9)
	Compactor	2	8	2.50 (2.27)	1173	0.04 (0.04)	0.5 (0.5)
	D-9 with ripper	4	8	3.05 (2.77)	1173	0.10 (0.09)	1.1 (1.0)
	641-B scraper	5	8	20.30 (18.41)	1173	0.81 (0.73)	9.5 (8.6)
	12-G grader	1	8	3.05 (2.77)	1173	0.02 (0.02)	0.3 (0.3)
Sub-Total		245				9.30 (8.44)	109.1 (99.0)
3	32-ton truck	3	500 (311)	0.24 (0.35)	1043	0.36 (0.33)	3.8 (3.4)
	Concrete truck	44	150 (93)	0.18 (0.26)	1043	1.19 (1.08)	12.4 (11.2)
	Semi	1	500 (311)	0.24 (0.35)	1043	0.12 (0.11)	1.3 (1.2)
	Water truck	196	160 (99)	0.23 (0.34)	1043	7.21 (6.54)	75.2 (68.2)
	Carry-all	2	20 (12)	0.03 (0.04)	1043	0.00 (0.00)	0.0 (0.0)
	Flatbed truck	11	20 (12)	0.23 (0.34)	1043	0.05 (0.05)	0.5 (0.5)
	D-5 dozer	8	8	8.25 (7.48)	1043	0.53 (0.48)	5.5 (5.0)
	Compactor	2	8	2.50 (2.27)	1043	0.04 (0.04)	0.4 (0.4)
	D-9 with ripper	4	8	3.05 (2.77)	1043	0.10 (0.09)	1.0 (0.9)
	641-B scraper	5	8	20.30 (18.41)	1043	0.81 (0.73)	8.5 (7.7)
	12-G grader	1	8	3.05 (2.77)	1043	0.02 (0.02)	0.3 (0.3)
Sub-Total		277				10.43 (9.46)	108.9 (98.8)
4	32-ton truck	3	500 (311)	0.24 (0.35)	1043	0.36 (0.33)	3.8 (3.4)
	Concrete truck	47	150 (93)	0.18 (0.26)	1043	1.27 (1.15)	13.2 (12.0)
	Semi	1	500 (311)	0.24 (0.35)	1043	0.12 (0.11)	1.3 (1.2)
	Water truck	208	160 (99)	0.23 (0.34)	1043	7.65 (6.94)	79.8 (72.4)
	Carry-all	3	20 (12)	0.03 (0.04)	1043	0.00 (0.00)	0.0 (0.0)
	Flatbed truck	11	20 (12)	0.23 (0.34)	1043	0.05 (0.05)	0.5 (0.5)
	D-5 dozer	9	8	8.25 (7.48)	1043	0.59 (0.54)	6.2 (5.6)
	Compactor	3	8	2.50 (2.27)	1043	0.06 (0.05)	0.6 (0.5)
	D-9 with ripper	4	8	3.05 (2.77)	1043	0.10 (0.09)	1.0 (0.9)
	641-B scraper	6	8	20.30 (18.41)	1043	0.97 (0.88)	10.2 (9.3)
	12-G grader	1	8	3.05 (2.77)	1043	0.02 (0.02)	0.3 (0.3)
Sub-Total		296				11.19 (10.15)	116.9 (106.0)
Total		1,137				43.01 (39.01)	484.7 (439.6)

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[a]All vehicles are diesel powered except carry-alls.

Table 4.1.2-23. NO_x motor vehicle emissions associated with DTN construction.

1 SEGMENT NUMBER	2 VEHICLE TYPE[1]	3 NUMBER OF VEHICLES	4 DISTANCE TRAVELED mi/day (km/day) OR OPERATING TIME hr/day	5 EMISSION FACTOR x 10^{-5} tons/mi (tonnes/km) OR tons/hr (tonnes/hr)	6 NUMBER OF CONSTRUCTION DAYS	7 EMISSIONS PER DAY X10^{-2} tons (tonnes) (3.)X(4.)X(5.)	8 TOTAL EMISSIONS tons (tonnes) (3.)X(4.)X(5.)X(6.)
	Spray Truck	2	20 (12)	2.19 (3.20)	586	0.09 (0.08)	0.5 (0.5)
	Semi	1	500 (311)	2.19 (3.20)	586	1.11 (1.01)	6.4 (5.8)
	Tank Truck	3	500 (311)	2.19 (3.20)	586	3.29 (2.98)	19.3 (17.5)
	Water Truck	170	160 (99)	2.19 (3.20)	586	59.57 (54.03)	349.1 (316.6)
	Carry All	3	20 (12)	0.25 (0.37)	586	0.02 (0.02)	0.1 (0.1)
	30-Ton Truck	32	240 (149)	2.19 (3.20)	586	16.82 (15.26)	98.6 (89.4)
	Off Road	39	8	381.5 (346.0)	586	119.03 (107.96)	697.5 (632.6)
	Truck			252.5(229.0)	586	34.34 (31.15)	201.2 (182.5)
1	D-5 Dozer	17	8	52.5 (47.6)	586	18.48 (16.76)	108.3 (98.2)
	12-G Grader	44	8	120.0(108.8)	586	2.88 (2.61)	16.9 (15.3)
	Backhoe	3	8	311.0(282.1)	586	57.22 (51.90)	335.3 (304.1)
	641-B Scraper	23	8	52.0 (47.2)	586	20.80 (18.87)	121.9 (110.6)
	Compactor	50	8	113.5(102.9)	586	2.72 (2.47)	16.0 (14.5)
	Pipelayer	3	8	52.0 (47.2)	586	1.66 (1.51)	9.8 (8.9)
	Paver	4	8	52.0 (47.2)	586	3.33 (3.02)	19.5 (17.7)
	Roller	8	8				
Sub Total		402				341.36(309.61)	2,000.4(1,184.4)
	Spray Truck	2	20 (12)	2.19 (3.20)	564	0.09 (0.08)	0.5 (0.5)
	Semi	1	500 (311)	2.19 (3.20)	564	1.10 (1.00)	6.2 (5.6)
	Tank Truck	3	500 (311)	2.19 (3.20)	564	3.29 (2.98)	18.5 (16.8)
	Water Truck	130	160 (99)	2.19 (3.20)	564	45.55 (41.31)	256.9 (233.0)
	Carry All	3	20 (12)	0.25 (0.37)	564	0.02 (0.02)	0.1 (0.1)
	30-ton Truck	24	240 (149	2.19 (3.20)	564	12.61 (11.44)	71.1 (64.5)
	Off Road Truck	31	8	381.5 (346.0)	564	94.61 (85.81)	533.6 (484.0)
2	D-5 Dozer	13	8	252.5(229.0)	564	26.26 (23.82)	148.1 (134.3)
	12-G Grader	34	8	52.5 (47.6)	564	14.26 (12.95)	80.5 (73.0)
	Backhoe	2	8	120.0(108.8)	564	1.92 (1.74)	10.8 (9.8)
	641-B Scraper	18	8	311.0(282.1)	564	44.78 (40.62)	252.6 (229.1)
	Compactor	36	8	52.0 (47.2)	564	15.81 (14.34)	89.2 (80.9)
	Pipelayer	2	8	113.5(102.9)	564	1.82 (1.65)	10.2 (9.3)
	Paver	3	8	52.0 (47.2)	564	1.25 (1.13)	7.0 (6.3)
	Roller	6	8	52.0 (47.2)	564	2.50 (2.27)	14.1 (12.8)
Sub Total		310				265.89(241.16)	1,499.4(1,360.0)
	Spray Truck	2	20 (12)	2.19 (3.20)	586	0.09 (0.08)	0.5 (0.5)
	Semi	1	500 (311)	2.19 (3.20)	586	1.10 (1.00)	6.4 (5.8)
	Tank Truck	3	500 (311)	2.19 (3.20)	586	3.29 (2.98)	19.3 (17.5)
	Water Truck	149	160 (99)	2.19 (3.20)	586	52.21 (47.35)	305.9 (277.5)
	Carry All	3	20 (12)	0.25 (0.37)	586	0.02 (0.02)	0.1 (0.1)
	30-ton Truck	27	240 (149)	2.19 (3.20)	586	14.19 (12.87)	83.2 (75.5)
	Off Road Truck	34	8	381.5 (346.0)	586	103.77 (94.12)	608.1 (551.5)
	D-5 Dozer	15	8	252.5(229.0)	586	30.30 (27.48)	177.6 (161.1)
3	12-G Grader	39	8	52.5 (47.6)	586	16.38 (14.86)	96.0 (87.1)
	Backhoe	2	8	120.0(108.8)	586	1.92 (1.74)	11.3 (10.2)
	641-B Scraper	20	8	311.0(282.1)	586	49.76 (45.13)	291.6 (264.5)
	Compactor	44	8	52.0 (47.2)	596	18.30 (16.60)	107.3 (97.3)
	Pipelayer	2	8	113.5(102.9)	586	1.82 (1.65)	10.6 (9.6)
	Paver	3	8	52.0 (47.2)	586	1.25 (1.13)	7.3 (6.6)
	Roller	7	8	52.0 (47.2)	586	2.91 (2.64)	17.1 (15.5)
Sub Total		351				297.31(269.66)	1,742.3(1,580.3)
	Spray Truck	2	20 (12)	2.19 (3.20)	500	0.09 (0.08)	0.4 (0.4)
	Semi	1	500 (311)	2.19 (3.20)	500	1.10 (1.00)	5.5 (5.0)
	Tank Truck	3	500 (311)	2.19 (3.20)	500	3.29 (2.98)	16.4 (14.9)
	Water Truck	158	160 (99)	2.19 (3.20)	500	55.36 (50.21)	276.8 (251.1)
	Carry All	3	20 (12)	0.25 (0.37)	500	0.02 (0.02)	0.1 (0.1)
	30-ton Truck	29	240 (149)	2.19 (3.20)	500	15.24 (13.82)	76.2 (69.1)
	Off Road Truck	36	8	381.5 (346.0)	500	109.87 (99.65)	549.4 (498.3)
4	D-5 Dozer	16	8	252.5(229.0)	500	32.32 (29.31)	161.6 (146.6)
	12-G Grader	41	8	52.5 (47.6)	500	17.22 (15.62)	86.1 (78.1)
	Backhoe	3	8	120.0(108.8)	500	2.88 (2.61)	14.4 (13.1)
	641-B Scraper	21	8	311.0(282.1)	500	52.25 (47.39)	261.2 (236.9)
	Compactor	46	8	52.0 (47.2)	500	19.14 (17.36)	96.7 (86.8)
	Pipelayer	3	8	113.5(102.9)	500	2.72 (2.47)	13.6 (12.3)
	Paver	4	8	52.0 (47.2)	500	1.66 (1.51)	8.3 (7.5)
	Roller	7	8	52.0 (47.2)	500	2.91 (2.64)	14.6 (13.2)
Sub Total		373				316.07(286.68)	1,580.3(1,433.3)
TOTAL		1,436				1,220.63(1,107.11)	6,822.4(6,187.9)

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[1]All vehicles are diesel powered except carry-alls.

Table 4.1.2-24. NO_x motor vehicle emissions associated with cluster road construction.

1 SEGMENT NUMBER	2 VEHICLE TYPE[1]	3 NUMBER OF VEHICLES	4 DISTANCE TRAVELED mi/day (km/day) OR OPERATING TIME hr/day	5 EMISSION FACTOR X 10^{-6} tons/mi (tonnes/km) OR tons/hr (tonnes/hr)	6 NUMBER OF CONSTRUCTION DAYS	7 EMISSIONS PER DAY X 10^{-2} ton (tonnes) (3.) x (4.) x (5.)	8 TOTAL EMISSIONS tons (tonnes) (3.) x (4.) x (5.) x (6.)
1	Semi	2	500 (311)	2.19 (3.20)	1151	2.19 (1.99)	25.2 (22.9)
	Tank truck	3	500 (311)	2.19 (3.20)	1151	3.29 (2.98)	37.8 (34.3)
	Water truck	233	160 (99)	2.19 (3.20)	1151	81.64 (74.05)	939.7 (852.3)
	Carry all	6	20 (12)	0.25 (0.37)	1151	0.03 (0.03)	0.3 (0.3)
	Off road truck	73	8	381.5 (346.0)	1151	222.80 (202.08)	2,564.4 (2,325.9)
	641-B scraper	8	8	311.0 (282.1)	1151	19.90 (18.05)	229.1 (207.8)
	D-5 dozer	13	8	252.5 (229.0)	1151	26.26 (23.82)	302.3 (274.2)
	12-G grader	40	8	52.5 (47.6)	1151	16.80 (15.24)	193.4 (175.4)
	Backhoe	5	8	120.0 (108.8)	1151	4.80 (4.35)	55.2 (50.1)
	Spreader	1	8	52.0 (47.2)	1151	.42 (0.38)	4.8 (4.4)
	Compactor	61	8	52.0 (47.2)	1151	25.38 (23.02)	292.1 (264.9)
	Pipelayer	5	8	113.5 (102.9)	1151	4.54 (4.12)	52.3 (47.4)
Sub-Total		453				408.05 (370.10)	4,696.6 (4,259.8)
2	Semi	1	500 (311)	2.19 (3.20)	934	1.10 (1.00)	10.2 (9.3)
	Tank truck	3	500 (311)	2.19 (3.20)	934	3.29 (2.98)	30.7 (27.8)
	Water truck	179	160 (99)	2.19 (3.20)	934	62.72 (56.89)	585.8 (531.3)
	Carry all	4	20 (12)	0.25 (0.37)	934	0.02 (0.02)	0.2 (0.2)
	Off road truck	56	8	381.5 (346.0)	934	170.91 (155.02)	1,596.3 (1,447.8)
	641-B scraper	7	8	311.0 (282.1)	934	17.42 (15.80)	162.7 (147.6)
	D-5 dozer	10	8	252.5 (229.0)	934	20.20 (18.32)	188.7 (171.2)
	12-G grader	30	8	52.5 (47.6)	934	12.60 (11.43)	117.7 (106.8)
	Backhoe	4	8	120.0 (108.8	934	38.40 (34.83)	35.9 (32.6)
	Spreader	1	8	52.0 (47.2)	934	0.43 (0.38)	3.9 (3.5)
	Compactor	47	8	52.0 (47.2)	934	19.55 (17.73)	182.6 (165.6)
	Pipelayer	4	8	113.5 (102.9)	934	3.63 (3.29)	33.9 (30.7)
Sub-Total		346				350.26 (317.69)	2,948.6 (2,674.4)
3	Semi	2	500 (311)	2.19 (3.20)	826	2.19 (1.99)	18.1 (16.4)
	Tank truck	3	500 (311)	2.19 (3.20)	826	3.29 (2.98)	27.1 (24.6)
	Water truck	204	160 (99)	2.19 (3.20)	826	71.48 (64.83)	590.4 (535.5)
	Carry all	5	20 (12)	0.25 (0.37)	826	0.03 (0.03)	0.2 (0.2)
	Off road truck	64	8	381.5 (346.0)	826	195.33 (177.16)	1,613.4 (1,463.4)
	641-B scraper	7	8	311.0 (282.1)	826	17.42 (15.80)	143.9 (130.5)
	D-5 dozer	12	8	252.5 (229.0)	826	24.24 (21.99)	200.2 (181.6)
	12-G grader	35	8	52.5 (47.6)	826	14.70 (13.33)	121.4 (110.1)
	Backhoe	4	8	120.0 (108.8)	826	3.84 (3.48)	31.7 (28.8)
	Spreader	1	8	52.0 (47.2)	826	0.42 (0.38)	3.4 (3.1)
	Compactor	53	8	52.0 (47.2)	826	22.05 (20.00)	182.1 (165.2)
	Pipelayer	4	8	113.5 (102.9)	826	3.63 (3.29)	30.0 (27.2)
Sub-Total		394				368.62 (325.27)	2,961.9 (2,686.4)
4	Semi	2	500 (311)	2.19 (3.20)	956	2.19 (1.99)	20.9 (19.0)
	Tank truck	3	500 (311)	2.19 (3.20)	956	3.29 (2.98)	31.4 (28.5)
	Water truck	216	160 (99)	2.19 (3.20)	956	75.69 (68.65)	723.6 (656.3)
	Carry all	5	20 (12)	0.25 (0.37)	956	0.03 (0.03)	0.2 (0.2)
	Off road truck	67	8	381.5 (346.0)	956	204.48 (185.46)	1,954.9 (1,773.1)
	641-B scraper	8	8	311.0 (282.1)	956	19.90 (18.05)	190.3 (172.6)
	D-5 dozer	13	8	252.5 (229.0)	956	26.26 (23.82)	251.0 (227.7)
	12-G grader	37	8	52.5 (47.6)	956	15.54 (14.09)	148.6 (134.8)
	Backhoe	4	8	120.0 (108.8)	956	3.84 (3.48)	36.7 (33.3)
	Spreader	1	8	52.0 (47.2)	956	0.42 (0.38)	4.0 (3.6)
	Compactor	57	8	52.0 (47.2)	956	23.71 (21.50)	226.7 (205.6)
	Pipelayer	4	8	113.5 (102.9)	956	3.63 (3.29)	34.7 (31.5)
Sub-Total		417				378.98 (343.73)	3,623.0 (3,286.1)
Total		1,607				1,495.91 (1,356.79)	14,230.1 (12,906.7)

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[1]All vehicles are diesel powered except carry-alls.

Table 4.1.2-25. NO_x motor vehicle emissions associated with shelter construction.

1 SEGMENT NUMBER	2 VEHICLE TYPE*	3 NUMBER OF VEHICLES	4 DIST. TRAVELED mi/day (km/day) OR OPERATING TIME hr/day	5 FACTOR x 10^{-5} tons/mi (tonnes/km) OR tons/hr (tonnes/hr)	6 NUMBER OF CONSTRUCTION DAYS	7 EMISSIONS PER DAY x 10^{2} tons (tonnes) (3.) x (4.) x (5.)	8 TOTAL EMISSIONS tons (tonnes) (3.) x (4.) x (5.) x (6.)
1	32-ton Truck	3	500 (311)	2.19 (3.20)	1,239	3.29 (2.98)	40.7 (36.9)
	Concrete Truck	50	150 (93)	2.19 (3.20)	1,239	16.43 (14.90)	203.5 (184.5)
	Semi	2	500 (311)	2.19 (311)	1,239	2.19 (1.99)	27.1 (24.6)
	Water Truck	224	160 (99)	2.19 (3.20)	1,239	78.49 (71.19)	972.5 (882.1)
	Carry All	3	20 (12)	0.25 (0.37)	1,239	0.02 (0.02)	0.2 (0.2)
	Flatbed Truck	12	20 (12)	2.19 (3.20)	1,239	0.53 (0.48)	6.5 (5.9)
	D-5 Dozer	10	8	252.5 (229.0)	1,239	20.20 (18.32)	250.3 (227.0)
	Compactor	3	8	52.0 (47.2)	1,239	1.25 (1.13)	15.5 (14.1)
	D-9 w/Ripper	4	8	52.5 (47.6)	1,239	1.68 (1.52)	20.8 (18.9)
	641-E Scraper	6	8	311.0 (282.1)	1,239	14.93 (13.54)	185.0 (167.8)
	12-G Grader	2	8	52.5 (47.6)	1,239	0.84 (0.76)	10.4 (9.4)
Subtotal		319				139.85 (126.84)	1,731.5 (1,571.4)
2	32-ton Truck	3	500 (311)	2.19 (3.20)	1,173	3.29 (2.98)	38.5 (34.9)
	Concrete Truck	39	150 (93)	2.19 (3.20)	1,173	12.81 (11.62)	150.3 (136.3)
	Semi	1	500 (311)	2.19 (3.20)	1,173	1.10 (1.00)	12.8 (11.6)
	Water Truck	171	160 (99)	2.19 (3.20)	1,173	59.92 (54.35)	702.8 (638.4)
	Carry All	2	20 (12)	0.25 (0.37)	1,173	0.01 (0.01)	0.1 (0.1)
	Flatbed Truck	10	20 (12)	2.19 (3.20)	1,173	0.44 (0.40)	5.1 (4.6)
	D-5 Dozer	7	8	252.5 (229.0)	1,173	14.14 (12.82)	165.9 (150.5)
	Compactor	2	8	52.0 (47.2)	1,173	0.83 (0.75)	9.8 (8.9)
	D-9 w/Ripper	4	8	52.5 (47.6)	1,173	1.68 (1.52)	19.7 (17.9)
	641-E Scraper	5	8	311.0 (282.1)	1,173	12.44 (11.28)	145.9 (132.3)
	12-G Grader	1	8	52.5 (47.6)	1,173	0.42 (0.38)	4.9 (4.4)
Subtotal		245				107.08 (97.12)	1,255.8 (1,139.0)
3	32-Ton Truck	3	500 (311)	2.19 (3.20)	1,043	3.29 (2.98)	34.3 (31.1)
	Concrete Truck	44	150 (93)	2.19 (3.20)	1,043	14.45 (13.11)	150.8 (136.8)
	Semi	1	500 (311)	2.19 (3.20)	1,043	1.10 (1.00)	11.4 (10.3)
	Water Truck	196	160 (99)	2.19 (3.20)	1,043	68.68 (62.29)	716.3 (649.7)
	Carry All	2	20 (12)	0.25 (0.37)	1,043	0.00 (0.00)	0.0 (0.0)
	Flatbed Truck	11	20 (12)	2.19 (3.20)	1,043	0.48 (0.44)	5.0 (4.5)
	D-5 Dozer	8	8	252.5 (229.0)	1,043	16.16 (14.66)	168.5 (152.8)
	Compactor	2	8	52.0 (47.2)	1,043	0.83 (0.75)	8.7 (7.9)
	D-9 w/Ripper	4	8	52.5 (47.6)	1,043	1.68 (1.52)	17.5 (15.9)
	641-E Scraper	5	8	311.0 (182.1)	1,043	12.44 (11.28)	129.7 (117.6)
	12-G Grader	1	8	52.5 (47.6)	1,043	0.42 (0.38)	4.4 (4.0)
Subtotal		277				119.53 (108.41)	1,246.6 (1130.7)
4	32-Ton Truck	3	500 (311)	2.19 (3.20)	1,043	3.29 (2.98)	34.3 (31.1)
	Concrete Truck	47	150 (93)	2.19 (3.20)	1,043	15.44 (14.00)	161.0 (146.0)
	Semi	1	500 (311)	2.19 (3.20)	1,043	1.10 (1.00)	11.4 (10.3)
	Water Truck	208	160 (99)	2.19 (3.20)	1,043	72.88 (66.10)	760.2 (689.5)
	Carry All	3	20 (12)	0.25 (0.37)	1,043	0.02 (0.02)	0.2 (0.2)
	Flatbed Truck	11	20 (12)	2.19 (3.20)	1,043	0.48 (0.44)	5.0 (4.5)
	D-5 Dozer	9	8	252.5 (229.0)	1,043	18.18 (16.49)	189.6 (172.0)
	Compactor	[illegible]	8	52.0 (47.2)	1,043	1.25 (1.13)	13.0 (11.8)
	D-9 w/Ripper	4	8	52.5 (47.6)	1,043	1.68 (1.52)	17.5 (15.9)
	641-E Scraper	[illegible]	8	311.0 (282.1)	1,043	14.93 (13.54)	155.7 (141.2)
	12-G Grader	[illegible]	8	52.5 (47.6)	1,043	0.42 (0.38)	4.4 (4.0)
Subtotal		29[illegible]				129.67 (117.61)	1,352.3 (1,226.5)
Total		1,13[illegible]				496.1[illegible] (449.49)	5,587.2 (5,067.6)

*All vehicles are diesel powered except carry-alls.

Table 4.1.2-26. CO motor vehicle emissions associated with DTN construction.

1	2	3	4	5	6	7	8
SEGMENT NUMBER	VEHICLE TYPE[a]	NUMBER OF VEHICLES	DISTANCE TRAVELED mi/day (km/day) OR OPERATING TIME hr/day	EMISSION FACTOR X 10[illegible] tons/mi (tonnes/km) OR tons/hr (tonnes/hr)	NUMBER OF CONSTRUCTION DAYS	EMISSIONS PER DAY X 10[illegible] tons (tonnes) (3.) x (4.) x (5.)	TOTAL EMISSIONS tons (tonnes) (3.) x (4.) x (5.) x (6.)
1	Spray truck	2	20 (12)	2.98 (4.35)	586	0.12 (0.11)	0.7 (0.6)
	Semi	1	500 (311)	2.98 (4.35)	586	1.49 (1.35)	8.7 (7.9)
	Tank Truck	3	500 (311)	2.98 (4.35)	586	4.47 (4.05)	26.2 (23.8)
	Water truck	17[illegible]	160 (99)	2.98 (4.35)	586	81.06 (73.52)	475.0 (430.8)
	Carry all	3	20 (12)	4.47 (6.53)	586	0.27 (0.24)	1.6 (1.4)
	30-ton truck	32	240 (149)	2.98 (4.35)	586	22.89 (20.76)	134.1 (121.6)
	Off road truck	39	8	67.00 (60.77)	586	20.90 (1[illegible].96)	122.5 (111.1)
	D-8 dozer	17	8	36.95 (33.51)	586	5.02 (4.55)	29.4 (26.7)
	12-G grader	44	8	10.75 (9.75)	586	3.78 (3.43)	22.1 (20.0)
	Backhoe	3	8	27.65 (25.08)	586	0.66 (0.60)	3.9 (3.5)
	641-B scraper	23	8	73.00 (66.21)	586	13.43 (12.18)	78.7 (71.4)
	Compactor	50	8	9.20 (8.34)	586	3.68 (3.34)	21.6 (19.6)
	Pipelayer	3	8	20.70 (18.77)	586	0.50 (0.45)	2.9 (2.6)
	Paver	4	8	9.20 (8.34)	586	0.29 (0.26)	1.7 (1.5)
	Roller	8	8	9.20 (8.34)	586	0.59 (0.53)	3.4 (3.1)
Sub-Total		40[illegible]				159.15 (144.35)	932.5 (845.8)
2	Spray truck	2	20 (12)	2.98 (4.35)	564	0.12 (0.11)	0.7 (0.6)
	Semi	1	500 (311)	2.98 (4.35)	564	1.49 (1.35)	8.4 (7.6)
	Tank truck	3	500 (311)	2.98 (4.35)	564	4.47 (4.05)	25.2 (22.9)
	Water truck	13[illegible]	160 (99)	2.98 (4.35)	564	61.98 (56.22)	349.6 (317.1)
	Carry all	3	20 (12)	4.47 (6.53)	564	[illegible] (2.42)	15.0 (13.6)
	30-ton truck	24	240 (149)	2.98 (4.35)	564	17.16 (15.56)	96.8 (87.8)
	Off road truck	3[illegible]	8	67.00 (60.77)	564	16.61 (15.06)	93.7 (85.0)
	D-8 dozer	13	8	36.95 (33.51)	564	3.84 (3.47)	21.7 (19.7)
	12-G grader	34	8	10.75 (9.75)	564	2.9[illegible] (2.65)	16.5 (15.0)
	Backhoe	2	8	27.65 (25.08)	564	0.44 (0.40)	2.5 (2.27)
	641-B scraper	16	8	73.00 (66.21)	564	10.51 (9.53)	59.3 (53.8)
	Compactor	36	8	9.20 (8.34)	564	2.74 (2.53)	15.6 (14.3)
	Pipelayer	2	8	20.70 (18.77)	564	0.33 (0.30)	1.9 (1.7)
	Paver	3	8	9.20 (8.34)	564	0.22 (0.20)	1.2 (1.1)
	Roller	6	8	9.20 (8.34)	564	0.44 (0.40)	2.5 (2.3)
Sub-Total		310				125.99 (114.27)	710.6 (644.7)
3	Spray truck	2	20 (12)	2.98 (4.35)	586	0.12 (0.11)	0.7 (0.6)
	Semi	1	500 (311)	2.98 (4.35)	586	1.49 (1.35)	8.7 (7.9)
	Tank truck	3	500 (311)	2.98 (4.35)	586	4.47 (4.05)	26.2 (23.8)
	Water truck	149	160 (99)	2.98 (4.35)	586	71.04 (64.43)	416.3 (377.6)
	Carry all	3	20 (12)	4.47 (6.53)	586	0.27 (0.24)	1.6 (1.5)
	30-ton truck	27	240 (149)	2.98 (4.35)	586	19.31 (17.51)	113.2 (102.7)
	Off road truck	34	8	67.00 (60.77)	586	18.22 (16.53)	106.8 (96.9)
	D-5 dozer	15	8	36.95 (33.51)	586	4.43 (4.02)	26.0 (23.6)
	12-G grader	39	8	10.75 (9.75)	586	3.35 (3.04)	19.6 (17.8)
	Backhoe	2	8	27.65 (25.08)	586	0.44 (0.40)	2.6 (2.4)
	641-B scraper	20	8	73.00 (66.21)	586	11.68 (10.59)	68.4 (62.0)
	Compactor	44	8	9.20 (8.34)	586	3.24 (2.94)	19.0 (17.2)
	Pipelayer	2	8	20.70 (18.77)	586	0.33 (0.30)	1.9 (1.7)
	Paver	3	8	9.20 (8.34)	586	0.22 (0.20)	1.3 (1.2)
	Roller	7	8	9.20 (8.34)	586	0.52 (0.47)	3.0 (2.7)
Sub-Total		35[illegible]				139.13 (126.19)	815.3 (739.5)
4	Spray truck	2	20 (12)	2.98 (4.35)	500	0.12 (0.11)	0.6 (0.5)
	Semi	1	500 (311)	2.98 (4.35)	500	1.49 (1.35)	7.5 (6.8)
	Tank truck	3	500 (311)	2.98 (4.35)	500	4.47 (4.05)	22.4 (20.3)
	Water truck	158	160 (99)	2.98 (4.35)	500	75.33 (68.32)	376.7 (341.7)
	Carry all	4	20 (12)	4.47 (6.53)	500	0.27 (0.24)	1.3 (1.2)
	30-ton truck	29	240 (149)	2.98 (4.35)	500	20.74 (18.81)	103.7 (94.1)
	Off road truck	36	8	67.00 (60.77)	500	19.30 (17.51)	96.5 (87.5)
	D-8 dozer	16	8	36.95 (33.51)	500	4.73 (4.29)	23.6 (21.4)
	12-G grader	41	8	10.75 (9.75)	500	3.53 (3.20)	17.6 (16.0)
	Backhoe	3	8	27.65 (25.08)	500	0.66 (0.60)	3.3 (3.0)
	641-B scraper	21	8	73.00 (66.21)	500	12.26 (11.12)	61.3 (55.6)
	Compactor	46	8	9.20 (8.34)	500	3.39 (3.07)	16.9 (15.3)
	Pipelayer	3	8	20.70 (18.77)	500	0.50 (0.45)	2.5 (2.3)
	Paver	4	8	9.20 (8.34)	500	0.29 (0.26)	1.5 (1.4)
	Roller	7	8	9.20 (8.34)	500	0.52 (0.47)	2.6 (2.4)
Sub-Total		[illegible]				147.60 (133.87)	738.0 (669.4)
Total		1,4[illegible]				571.87 (518.69)	3,196.6 (2,899.3)

[a]All vehicles are diesel powered except carry-alls.

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Table 4.1.2-27. CO motor vehicle emissions associated with cluster road construction.

1 SEGMENT NUMBER	2 VEHICLE TYPE*	3 NUMBER OF VEHICLES	4 DISTANCE TRAVELED mi/day (km/day) OR OPERATING TIME hr/day	5 EMISSION FACTOR x 10^{-5} tons/mi (tonnes/mi) OR tons/hr (tonnes/hr)	6 NUMBER OF CONSTRUCTION DAYS	7 EMISSIONS PER DAY x 10^{-2} tons (tonnes) (3.) x (4.) x (5.)	8 TOTAL EMISSIONS tons (tonnes) (3.) x (4.) x (5.) x (6.)
1	Semi	2	500 (311)	2.98 (4.35)	1151	2.98 (2.70)	34.3 (31.1)
	Tank truck	3	500 (311)	2.98 (4.35)	1151	4.47 (4.05)	51.4 (46.6)
	Water truck	233	160 (99)	2.98 (4.35)	1151	111.09 (100.76)	1,278.7 (1,159.8)
	Carry all	6	20 (12)	4.47 (6.53)	1151	0.54 (0.49)	6.2 (5.6)
	Off road truck	73	8	67.00 (60.77)	1151	39.13 (35.49)	450.4 (408.5)
	641-B scraper	8	8	73.00 (66.21)	1151	4.67 (4.24)	53.8 (48.8)
	D-5 dozer	13	8	36.95 (33.51)	1151	3.84 (3.48)	44.2 (40.1)
	12-G grader	40	8	10.75 (9.75)	1151	3.44 (3.12)	39.6 (35.9)
	Backhoe	5	8	27.65 (25.08)	1151	1.11 (1.01)	12.7 (11.5)
	Spreader	1	8	9.20 (8.34)	1151	0.07 (0.06)	8.2 (7.4)
	Compactor	61	8	9.20 (8.34)	1151	4.49 (4.07)	51.7 (46.9)
	Pipelayer	5	8	20.70 (18.77)	1151	0.83 (0.75)	9.5 (8.6)
Sub-Total		450				176.66 (160.23)	2,040.7 (1,850.9)
2	Semi	1	500 (311)	2.98 (4.35)	934	1.49 (1.35)	13.9 (12.6)
	Tank truck	3	500 (311)	2.98 (4.35)	934	4.47 (4.05)	41.7 (37.8)
	Water truck	179	160 (99)	2.92 (4.35)	934	83.63 (75.85)	781.1 (708.5)
	Carry all	4	20 (12)	4.47 (6.53)	934	0.36 (0.33)	3.3 (3.0)
	Off road truck	56	8	67.00 (60.77)	934	30.02 (27.23)	280.3 (254.2)
	641-B Scraper	7	8	73.00 (66.21)	934	4.09 (3.71)	38.2 (34.6)
	D-5 dozer	10	8	36.95 (33.51)	934	2.96 (2.68)	27.6 (25.0)
	12-G grader	30	8	10.75 (9.75)	934	2.58 (2.34)	24.1 (21.9)
	Backhoe	4	8	27.65 (25.08)	934	0.88 (0.80)	8.3 (7.5)
	Spreader	1	8	9.20 (8.34)	934	0.07 (0.06)	0.7 (0.6)
	Compactor	47	8	9.20 (8.34)	934	3.46 (3.14)	32.3 (29.3)
	Pipelayer	4	8	20.70 (18.77)	934	0.66 (0.60)	6.2 (5.6)
Sub-Total		346				134.67 (122.15)	1,257.7 (1,140.7)
3	Semi	2	500 (311)	2.98 (4.35)	826	2.98 (2.70)	24.6 (22.3)
	Tank truck	3	500 (311)	2.98 (4.35)	826	4.47 (4.05)	36.9 (33.5)
	Water truck	204	160 (99)	2.98 (4.35)	826	97.27 (88.22)	803.4 (728.7)
	Carry all	5	20 (12)	4.47 (6.53)	826	0.45 (0.41)	3.7 (3.4)
	Off road truck	64	8	67.00 (60.77)	826	34.30 (31.11)	283.4 (257.0)
	641-B scraper	7	8	73.00 (66.21)	826	4.09 (3.71)	337.9 (306.5)
	D-5 dozer	12	8	36.95 (33.51)	826	3.55 (3.22)	29.3 (26.6)
	12-G grader	35	8	10.75 (9.75)	826	3.01 (2.73)	24.9 (22.6)
	Backhoe	4	8	27.65 (25.08)	826	0.88 (0.80)	7.3 (6.6)
	Spreader	1	8	9.20 (8.34)	826	0.07 (0.06)	0.6 (0.5)
	Compactor	53	8	9.20 (8.34)	826	3.90 (3.54)	32.2 (29.2)
	Pipelayer	4	8	20.70 (18.77)	826	0.66 (0.60)	5.5 (5.0)
Sub-Total		394				155.63 (141.16)	1,589.7 (1,441.9)
4	Semi	2	500 (311)	2.98 (4.35)	956	2.98 (2.70)	28.5 (25.8)
	Tank truck	3	500 (311)	2.98 (4.35)	956	4.47 (4.05)	42.7 (38.7)
	Water truck	216	160 (99)	2.98 (4.35)	956	102.99 (93.41)	984.6 (893.0)
	Carry all	5	20 (12)	4.47 (6.53)	956	0.45 (0.41)	4.3 (3.9)
	Off road truck	67	8	67.00 (60.77)	956	35.91 (32.57)	343.3 (311.4)
	641-B scraper	8	8	73.00 (66.21)	956	4.67 (4.24)	44.7 (40.5)
	D-5 dozer	13	8	36.95 (33.51)	956	3.84 (3.48)	36.7 (33.3)
	12-G grader	37	8	10.75 (9.75)	956	3.18 (2.88)	30.4 (27.6)
	Backhoe	4	8	27.65 (25.08)	956	6.88 (6.[illegible])	84.9 (77.[illegible])
	Spreader	1	8	9.20 (8.34)	956	0.07 (0.06)	0.7 (0.6)
	Compactor	57	8	9.20 (8.34)	956	4.2[illegible] (3.81)	40.1 (36.4)
	Pipelayer	4	8	20.70 (18.77)	956	0.66 (0.60)	6.3 (5.7)
Sub-Total		417				17[illegible] (157.18)	1,647.2 (1,494.0)
Total		1,607				64[illegible] (58[illegible])	6,535.3 (5,927.5)

*All vehicles are diesel powered except carry-alls.

11[illegible]

Table 4.1.2-28. CO motor vehicle emissions associated with shelter construction.

1 SEGMENT NUMBER	2 VEHICLE TYPE*	3 NUMBER OF VEHICLES	4 DISTANCE TRAVELED mi/day (km/day) OR OPERATING TIME hr/day	5 EMISSION FACTOR x 10^{-5} tons/mi (tonnes/km) OR tons/hr (tonnes/hr)	6 NUMBER OF CONSTRUCTION DAYS	7 EMISSIONS PER DAY x 10^{-2} tons (tonnes) (3.) x (4.) x (5.)	8 TOTAL EMISSIONS tons (tonnes) (3.) x (4.) x (5.) x (6.)
1	32-Ton Truck	3	500 (311)	2.98 (4.35)	1,239	4.47 (4.05)	55.4 (50.2)
	Concrete Truck	50	150 (93)	2.98 (4.35)	1,239	22.35 (20.27)	276.9 (251.2)
	Semi	2	500 (311)	2.98 (4.35)	1,239	2.98 (2.70)	36.9 (33.5)
	Water Truck	224	160 (99)	2.98 (4.35)	1,239	106.80 (96.87)	1,323.3 (1,200.2)
	Carry All	3	20 (12)	4.47 (6.53)	1,239	0.27 (0.24)	3.3 (3.0)
	Flatbed Truck	12	20 (12)	2.98 (4.35)	1,239	0.72 (0.65)	8.9 (8.1)
	D-5 Dozer	10	8	36.95 (33.51)	1,239	2.96 (2.68)	36.6 (33.2)
	Compactor	3	8	9.20 (8.34)	1,239	0.22 (0.20)	2.7 (2.4)
	D-9 w/Ripper	4	8	10.75 (9.75)	1,239	0.34 (0.31)	4.3 (3.9)
	641-B Scraper	6	8	73.00 (66.21)	1,239	3.50 (3.17)	43.4 (39.4)
	12-G Grader	2	8	10.75 (9.75)	1,239	0.17 (0.15)	2.1 (1.9)
Sub-total		319				144.78 (131.32)	1,793.8 (1,627.0)
2	32-Ton Truck	3	500 (311)	2.98 (4.35)	1,173	4.47 (4.05)	52.4 (47.5)
	Concrete Truck	39	150 (93)	2.98 (4.35)	1,173	17.43 (15.81)	204.5 (185.5)
	Semi	1	500 (311)	2.98 (4.35)	1,173	1.49 (1.35)	17.5 (15.9)
	Water Truck	171	160 (99)	2.98 (4.35)	1,173	81.53 (73.95)	956.4 (867.5)
	Carry All	2	20 (12)	4.47 (6.53)	1,173	0.18 (0.16)	2.1 (1.9)
	Flatbed Truck	10	20 (12)	2.98 (4.35)	1,173	0.60 (0.54)	7.0 (6.3)
	D-5 Dozer	7	8	36.95 (33.51)	1,173	2.07 (1.88)	24.3 (22.0)
	Compactor	2	8	9.20 (8.34)	1,173	0.15 (0.14)	1.7 (1.5)
	D-9 w/Ripper	4	8	10.75 (9.75)	1,173	0.34 (0.31)	4.0 (3.6)
	641-B Scraper	5	8	73.00 (66.21)	1,173	2.92 (2.65)	34.3 (31.1)
	12-G Grader	1	8	10.75 (9.75)	1,173	0.09 (0.08)	1.0 (0.9)
Sub-total		245				111.27 (100.92)	1,305.2 (1,183.8)
3	32-Ton Truck	3	500 (311)	2.98 (4.35)	1,043	4.47 (4.05)	46.6 (42.3)
	Concrete Truck	44	150 (93)	2.98 (4.35)	1,043	19.67 (17.84)	205.1 (186.0)
	Semi	1	500 (311)	2.98 (4.35)	1,043	1.49 (1.35)	15.5 (14.1)
	Water Truck	196	160 (99)	2.98 (4.35)	1,043	93.45 (84.76)	974.7 (884.1)
	Carry All	2	20 (12)	4.47 (6.53)	1,043	0.18 (0.16)	1.9 (1.7)
	Flatbed Truck	11	20 (12)	2.98 (4.35)	1,043	0.66 (0.60)	6.8 (6.2)
	D-5 Dozer	8	8	36.95 (33.51)	1,043	2.36 (2.14)	24.7 (22.4)
	Compactor	2	8	9.20 (8.34)	1,043	0.15 (0.14)	1.5 (1.4)
	D-9 w/Ripper	4	8	10.75 (9.75)	1,043	3.54 (3.21)	37.0 (33.6)
	641-B Scraper	5	8	73.00 (66.21)	1,043	2.92 (2.65)	30.5 (27.7)
	12-G Grader	1	8	10.75 (9.75)	1,043	0.09 (0.08)	0.9 (0.8)
Sub-total		277				128.98 (116.98)	1,345.2 (1,220.1)
4	32-Ton Truck	3	500 (311)	2.98 (4.35)	1,043	4.47 (4.05)	46.6 (42.3)
	Concrete Truck	47	150 (93)	2.98 (4.35)	1,043	21.01 (19.06)	219.1 (196.7)
	Semi	1	500 (311)	2.98 (4.35)	1,043	1.49 (1.35)	15.5 (14.1)
	Water Truck	208	160 (99)	2.98 (4.35)	1,043	99.17 (89.95)	1,034.4 (938.2)
	Carry All	3	20 (12)	4.47 (6.53)	1,043	0.27 (0.24)	2.8 (2.5)
	Flatbed Truck	11	20 (12)	2.98 (4.35)	1,043	6.62 (6.00)	69.0 (62.6)
	D-5 Dozer	9	8	36.95 (33.51)	1,043	2.66 (2.41)	27.7 (25.1)
	Compactor	3	8	9.20 (8.34)	1,043	0.22 (0.20)	2.3 (2.1)
	D-9 w/Ripper	4	8	10.75 (9.75)	1,043	0.34 (0.31)	3.6 (3.3)
	641-B Scraper	6	8	73.00 (66.21)	1,043	3.50 (3.17)	36.5 (33.1)
	12-G Grader	1	8	10.75 (9.75)	1,043	0.09 (0.08)	0.9 (0.8)
Sub-total		296				139.84 (126.83)	1,458.4 (1,322.8)
Total		1,137				524.87 (476.06)	5,902.6 (5,353.7)

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*All vehicles are diesel powered except carry alls.

Table 4.1.2-29. SO_X motor vehicle emissions associated with DTN construction.

1	2	3	4	5	6	7	8
SEGMENT NUMBER	VEHICLE TYPE[1]	NUMBER OF VEHICLES	DISTANCE TRAVELED mi/day (km/day) OR OPERATING TIME (hr/day)	EMISSION FACTOR x 10[illegible] tons/mi (tonnes/km) OR tons/hr (tonnes/hr)	NUMBER OF CONSTRUCTION DAYS	EMISSIONS PER DAY x 10[illegible] tons (tonnes) (3.) x (4.) x (5.)	TOTAL EMISSIONS tons (tonnes) (3.)x(4.)x(5.)x(6.)
1	Spray truck	2	20 (12)	0.31 (0.45)	586	0.01 (0.01)	0.1 (0.1)
	Semi	1	500 (311)	0.31 (0.45)	586	0.16 (0.15)	0.9 (0.8)
	Tank Truck	3	500 (311)	0.31 (0.45)	586	0.47 (0.43)	2.7 (2.4)
	Water truck	170	160 (99)	0.31 (0.45)	586	8.43 (7.65)	49.4 (44.8)
	Carry All	3	20 (12)	—[2]	586	—[2]	—[2]
	30-Ton truck	32	240 (149)	0.31 (0.45)	586	2.38 (2.16)	14.0 (12.7)
	Off-rd truck	39	8	22.70 (20.59)	586	7.08 (6.42)	41.5 (37.6)
	D-5 dozer	17	8	17.40 (15.78)	586	2.37 (2.15)	13.9 (12.6)
	12-G grader	44	8	4.30 (3.90)	586	1.51 (1.37)	8.9 (8.1)
	Backhoe	3	8	9.10 (8.25)	586	0.22 (0.20)	1.3 (1.2)
	641-B scraper	23	8	23.15 (21.00)	586	4.26 (3.86)	25.0 (22.7)
	Compactor	50	8	3.35 (3.04)	586	1.34 (1.22)	7.9 (7.2)
	Pipelayer	3	8	7.15 (6.49)	586	0.17 (0.15)	1.0 (0.9)
	Paver	4	8	3.35 (3.04)	586	0.11 (0.10)	0.6 (0.5)
	Roller	8	8	3.35 (3.04)	586	0.21 (0.19)	1.3 (1.2)
Sub-Total		402				28.72 (26.05)	168.5 (152.8)
2	Spray truck	2	20 (12)	0.31 (0.45)	564	0.01 (0.01)	0.1 (0.1)
	Semi	1	500 (311)	0.31 (0.45)	564	0.16 (0.15)	0.9 (0.8)
	Tank truck	3	500 (311)	0.31 (0.45)	564	0.47 (0.43)	2.6 (2.4)
	Water truck	130	160 (99)	0.31 (0.45)	564	6.45 (5.85)	36.4 (33.0)
	Carry all	3	20 (12)	—[2]	564	—	—
	30-ton truck	24	240 (149)	0.31 (0.45)	564	1.79 (1.62)	10.1 (9.2)
	Off-rd truck	31	8	22.70 (20.59)	564	—	—
	D-5 dozer	13	8	17.40 (15.78)	564	1.81 (1.64)	10.2 (9.3)
	12-G grader	34	8	4.30 (3.90)	564	1.17 (1.06)	6.6 (6.0)
	Backhoe	2	8	9.10 (8.25)	564	0.15 (0.14)	0.8 (0.7)
	641-B scraper	18	8	23.15 (21.00)	564	3.33 (3.02)	18.8 (17.1)
	Compactor	38	8	3.35 (3.04)	564	1.02 (0.93)	5.7 (5.2)
	Pipelayer	2	8	7.15 (6.49)	564	0.11 (0.10)	0.6 (0.5)
	Paver	3	8	3.35 (3.04)	564	0.08 (0.07)	0.5 (0.5)
	Roller	6	8	3.35 (3.04)	564	0.16 (0.15)	0.9 (0.8)
Sub - Total		310				22.34 (20.26)	126.0 (114.3)
3	Spray truck	2	20 (12)	0.31 (0.45)	586	0.01 (0.01)	0.1 (0.1)
	Semi	1	500 (311)	0.31 (0.45)	586	0.16 (0.15)	0.9 (0.8)
	Tank truck	3	500 (311)	0.31 (0.45)	586	0.47 (0.43)	2.7 (2.4)
	Water truck	149	160 (99)	0.31 (0.45)	586	7.39 (6.70)	43.3 (39.3)
	Carry all	3	20 (12)	—[2]	586	—	—
	30-ton truck	27	240 (149)	0.31 (0.45)	586	2.01 (1.82)	11.8 (10.7)
	Off-rd truck	34	8	22.70 (20.59)	586	6.17 (5.60)	36.2 (32.8)
	D-5 dozer	15	8	17.40 (15.78)	586	2.09 (1.90)	12.2 (11.1)
	12-G grader	39	8	4.30 (3.90)	586	1.34 (1.22)	7.9 (7.2)
	Backhoe	2	8	9.10 (8.25)	586	0.15 (0.14)	0.9 (0.8)
	641-B scraper	20	8	23.15 (21.00)	586	3.70 (3.36)	21.7 (19.7)
	Compactor	44	8	3.35 (3.04)	586	1.18 (1.07)	6.9 (6.3)
	Pipelayer	2	8	7.15 (6.49)	586	0.11 (0.10)	0.7 (0.6)
	Paver	3	8	3.35 (3.04)	586	0.08 (0.07)	0.5 (0.5)
	Roller	7	8	3.35 (3.04)	586	0.19 (0.17)	1.1 (1.0)
Sub-Total		351				25.05 (22.72)	146.9 (133.2)
4	Spray truck	2	20 (12)	0.31 (0.45)	500	0.01 (0.01)	0.1 (0.1)
	Semi	1	500 (311)	0.31 (0.45)	500	0.16 (0.15)	0.8 (0.7)
	Tank truck	3	500 (311)	0.31 (0.45)	500	0.47 (0.43)	2.3 (2.1)
	Water truck	158	160 (99)	0.31 (0.45)	500	7.84 (7.11)	39.2 (35.6)
	Carry all	3	20 (12)	—[2]	500	—	—
	30-ton truck	29	240 (149)	0.31 (0.45)	500	2.16 (1.96)	10.8 (9.8)
	Off-rd truck	36	8	22.70 (20.59)	500	6.54 (5.93)	32.7 (29.7)
	D-5 dozer	16	8	17.40 (15.78)	500	2.23 (2.02)	11.1 (10.1)
	12-G grader	41	8	4.30 (3.90)	500	1.41 (1.28)	7.1 (6.4)
	Backhoe	3	8	9.10 (8.25)	500	0.22 (0.20)	1.1 (1.0)
	641-B scraper	21	8	23.15 (21.00)	500	3.89 (3.53)	19.4 (17.6)
	Compactor	46	8	3.35 (3.04)	500	1.23 (1.12)	6.2 (5.6)
	Pipelayer	3	8	7.15 (6.49)	500	0.17 (0.15)	0.9 (0.8)
	Paver	4	8	3.35 (3.04)	500	0.11 (0.10)	0.5 (0.5)
	Roller	7	8	3.35 (3.04)	500	0.19 (0.17)	0.9 (0.8)
Sub-Total		373				26.63 (24.15)	133.1 (120.7)
Total		1,436				102.74 (93.19)	574.5 (521.1)

[1]All vehicles are diesel powered except carry-alls.

[2]SO_x emissions for this category are relatively insignificant

Table 4.1.2-30. SO_x motor vehicle emissions associated with cluster road construction.

SEGMENT NUMBER	VEHICLE TYPE[a]	NUMBER OF VEHICLES	DISTANCE TRAVELED mi/day (km/day) OR OPERATING TIME hr/day	EMISSION FACTOR x 10[illegible] tons/mi (tonnes/km) OR tons/hr (tonnes/hr)	NUMBER OF CONSTRUCTION DAYS	EMISSIONS PER DAY x 10[illegible] tons (tonnes) [illegible]	TOTAL EMISSIONS tons (tonnes) [illegible]
1	Semi	2	500 (311)	0.31 (0.45)	1151	[illegible]	[illegible]
	Tank truck	3	500 (311)	0.31 (0.45)	1151	0.47 (0.43)	[illegible]
	Water truck	233	160 (99)	0.31 (0.45)	1151	11.56 ([illegible].48)	133 [illegible]
	Carry all	[illegible]	20 (12)	—	1151	—	—
	Off road truck	73	8	22.7[illegible] ([illegible])	1151	13.26 (12.[illegible])	152.6 ([illegible])
	641-B scraper	8	8	23.1[illegible] (21.[illegible])	1151	1.48 (1.[illegible])	17.1 (15.[illegible])
	D-5 dozer	13	8	17.40 (15.78)	1151	1.81 (1.64)	20.8 (18.[illegible])
	12-G grader	40	8	4.30 (3.90)	1151	1.38 (1.25)	15.8 (14.[illegible])
	Backhoe	5	8	9.10 (8.25)	1151	0.36 (0.33)	4.2 (3.8)
	Spreader	1	8	3.35 (3.04)	1151	0.03 (0.03)	0.3 (0.3)
	Compactor	61	8	3.35 (3.04)	1151	1.63 (1.48)	18.8 (17.[illegible])
	Pipe layer	5	8	7.15 (6.49)	1151	0.29 (0.26)	3.3 (3.0)
Sub-Total		450				32.58 (29.55)	374.9 (340.0)
2	Semi	1	500 (311)	0.31 (0.45)	934	0.16 (0.15)	1.4 (1.3)
	Tank truck	3	500 (311)	0.31 (0.45)	934	0.47 (0.43)	4.3 (3.9)
	Water truck	179	160 (99)	0.31 (0.45)	934	8.88 (8.05)	82.9 (75.2)
	Carry all	4	20 (12)	—	934	—	—
	Off road truck	56	8	22.70 (20.59)	934	10.17 (9.22)	95.0 (86.2)
	641-B scrapper	7	8	23.15 (21.00)	934	14.26 (12.93)	133.2 (120.8)
	D-5 dozer	10	8	17.40 (15.78)	934	1.39 (1.26)	13.0 (11.8)
	12-G grader	3	8	4.30 (3.90)	934	1.03 (0.93)	9.6 (8.7)
	Backhoe	4	8	9.10 (8.25)	934	0.29 (0.26)	2.7 (2.4)
	Spreader	1	8	3.35 (3.04)	934	0.03 (0.03)	0.3 (0.3)
	Compactor	47	8	3.35 (3.04)	934	1.26 (1.14)	11.8 (10.7)
	Pipelayer	4	8	7.15 (6.49)	934	0.23 (0.21)	2.1 (1.9)
Sub-Total		346				38.17 (34.62)	356.3 (323.2)
3	Semi	2	500 (311)	0.31 (0.45)	826	0.31 (0.28)	2.6 (2.4)
	Tank truck	3	500 (311)	0.31 (0.45)	826	0.47 (0.43)	3.8 (3.4)
	Water truck	204	160 (99)	0.31 (0.45)	826	10.12 (9.18)	83.[illegible] (75.8)
	Carry all	[illegible]	20 (12)	—	826	—	—
	Off road truck	64	8	22.70 (20.59)	826	11.62 (10.54)	96.[illegible] (87.[illegible])
	641-B scraper	7	8	23.15 (21.00)	826	1.30 (1.18)	10.7 (9.7)
	D-5 dozer	12	8	17.40 (15.78)	826	1.67 (1.51)	13.8 (12.5)
	12-G grader	35	8	4.30 (3.90)	826	1.2[illegible] (1.[illegible])	[illegible]
	Backhoe	4	8	9.10 (8.25)	826	0.29 (0.26)	2.4 ([illegible])
	Spreader	1	8	3.35 (3.04)	826	0.03 (0.03)	[illegible]
	Compactor	53	8	3.35 (3.04)	826	1.42 (1.29)	11.7 ([illegible])
	Pipelayer	4	8	7.15 (6.49)	826	0.23 (0.21)	[illegible]
Sub-Total		394				28.66 (25.99)	236.[illegible] (214.[illegible])
4	Semi	2	500 (311)	0.31 (0.45)	956	0.31 (0.28)	[illegible]
	Tank truck	3	500 (311)	0.31 (0.45)	956	0.47 (0.43)	4.4 (4.[illegible])
	Water truck	216	160 (99)	0.31 (0.45)	956	10.71 (9.71)	[illegible]
	Carry all	5	20 (12)	—	956	—	—
	Off road truck	67	8	22.70 (20.59)	956	12.17 (11.04)	[illegible]
	641-B scraper	8	8	23.15 (21.00)	956	1.48 (1.34)	14.[illegible] (12.[illegible])
	D-5 dozer	13	8	17.40 (15.78)	956	1.81 (1.64)	[illegible]
	12-G grader	37	8	4.30 (3.90)	956	1.27 (1.15)	[illegible]
	Backhoe	4	8	9.10 (8.25)	956	0.29 (0.26)	[illegible]
	Spreader	1	8	3.35 (3.04)	956	0.03 (0.03)	[illegible]
	Compactor	57	8	3.35 (3.04)	956	1.53 (1.39)	14.[illegible] (13.[illegible])
	Pipelayer	4	8	7.15 (6.49)	956	0.23 (0.21)	[illegible]
Sub-Total		417				30.30 (27.48)	289.[illegible] (262.[illegible])
Total		1,607				129.71 (117.65)	1,2[illegible] (1,14[illegible])

[a]All vehicles are diesel powered except carry-alls.

[b]SO_x emissions for this category are relatively insignificant.

Table 4.1.2-31. SO_x motor vehicle emissions associated with shelter construction.

[illegible] ELEMENT NUMBER	VEHICLE TYPE	NUMBER OF VEHICLES	DISTANCE TRAVELED mi/day (km/day) or OPERATING TIME hr/day	EMISSION FACTOR x 10⁻⁵ tons/mi (tonnes/km) or tons/hr (tonnes/hr)	NUMBER OF CONSTRUCTION DAYS	EMISSIONS PER DAY x 10⁻² tons (tonnes) (3)X(4)X(5)	TOTAL EMISSIONS tons (tonnes) (3)X(4)X(5)X(6)
1	32-ton Truck	[illegible]	50 (31)	0.31 (0.45)	1,239	0.47 (0.43)	5.7 (5.2)
	Concrete Truck	[illegible]	150 (93)	0.31 (0.45)	1,239	2.33 (2.11)	26.8 (26.1)
	Semi	[illegible]	500 (311)	0.31 (0.45)	1,239	[illegible] (0.28)	3.8 (3.4)
	Water Truck	[illegible]	160 (99)	0.31 (0.45)	1,239	11.11 (10.08)	137.7 (124.9)
	Carry All	[illegible]	20 (12)	—[a]	1,239	—	—
	Flatbed Truck	[illegible]	20 (12)	0.31 (0.45)	1,239	0.07 (0.06)	[illegible]
	D-[illegible] Dozer	[illegible]	8	17.40 (15.78)	1,239	1.39 (1.26)	17.2 (15.6)
	Compactor	[illegible]	8	3.35 (3.04)	1,239	0.06 (0.0[illegible])	[illegible]
	D-9 W/Ripper	4	8	4.30 (3.90)	1,239	0.14 (0.13)	1.7 (1.5)
	641-B Scraper	[illegible]	8	23.15 (21.00)	1,239	1.11 (1.01)	13.8 (12.5)
	12-G Grader	[illegible]	8	4.30 (3.90)	1,239	0.07 (0.06)	0.9 (0.8)
Sub Total		21[illegible]				17.06 (15.49)	211.5 (191.6)
2	32-ton Truck	[illegible]	50 (31)	0.31 (0.45)	1,173	0.47 (0.43)	5.5 (5.0)
	Concrete Truck	[illegible]	150 (93)	0.31 (0.45)	1,173	1.81 (1.64)	21.3 (19.3)
	Semi	1	500 (311)	0.31 (0.45)	1,173	0.16 (0.15)	1.8 (1.6)
	Water Truck	17[illegible]	160 (99)	0.31 (0.45)	1,173	8.48 (7.69)	99.5 (9[illegible].2)
	Carry All	1	20 (12)	—[a]	1,173	—	—
	Flatbed Truck	1[illegible]	20 (12)	0.31 (0.45)	1,173	0.06 (0.05)	0.7 (0.6)
	D-[illegible] Dozer	[illegible]	8	17.40 (15.78)	1,173	0.97 (0.86)	11.4 (10.3)
	Compactor	2	8	3.35 (3.04)	1,173	0.05 (0.05)	0.6 (0.5)
	D-9 W Ripper	4	8	4.30 (3.90)	1,173	0.14 (0.13)	1.6 (1.5)
	641-B Scraper	[illegible]	8	23.15 (21.00)	1,173	0.93 (0.84)	10.9 (9.9)
	12-G Grader	1	8	4.30 (3.90)	1,173	0.03 (0.03)	0.4 (0.4)
Sub Total		245				13.12 (11.88)	153.7 (139.4)
3	32-ton Truck	3	500 (311)	0.31 (0.45)	1,043	0.47 (0.43)	4.8 (4.4)
	Concrete Truck	44	150 (93)	0.31 (0.45)	1,043	2.05 (1.86)	21.3 (19.3)
	Semi	1	500 (311)	0.31 (0.45)	1,043	0.16 (0.15)	1.6 (1.5)
	Water Truck	196	160 (99)	0.31 (0.45)	1,043	9.72 (8.82)	101.4 (92.0)
	Carry All	2	20 (12)	—[a]	1,043	—	—
	Flatbed Truck	11	20 (12)	0.31 (0.45)	1,043	0.07 (0.06)	0.7 (0.6)
	D-5 Dozer	8	8	17.40 (15.78)	1,043	1.11 (1.01)	11.6 (10.5)
	Compactor	2	8	3.35 (3.04)	1,043	0.05 (0.05)	0.6 (0.5)
	D-9 W/Ripper	4	8	4.30 (3.90)	1,043	0.14 (0.13)	1.4 (1.3)
	641-B Scrapper	5	8	23.15 (21.00)	1,043	0.93 (0.84)	9.7 (8.8)
	12-G Grader	1	8	4.30 (3.90)	1,043	0.03 (0.03)	0.4 (0.4)
Sub Total		27[illegible]				14.73 (13.36)	153.5 (139.2)
4	32-ton Truck	3	500 (311)	0.31 (0.45)	1,043	0.47 (0.43)	4.8 (4.4)
	Concrete Truck	47	150 (93)	0.31 (0.45)	1,043	2.19 (1.99)	22.8 (20.7)
	Semi	1	500 (311)	0.31 (0.45)	1,043	0.16 (0.15)	1.6 (1.5)
	Water Truck	2[illegible]	160 (99)	0.31 (0.45)	1,043	10.32 (9.36)	107.6 (97.6)
	Carry All	[illegible]	20 (12)	—[a]	1,043	—	—
	Flatbed Truck	11	20 (12)	0.31 (0.45)	1,043	0.07 (0.06)	0.7 (0.6)
	D-[illegible] Dozer	[illegible]	8	17.40 (15.78)	1,043	1.25 (1.13)	13.1 (11.4)
	Compactor	[illegible]	8	3.35 (3.04)	1,043	0.08 (0.07)	[illegible]
	D-9 W Ripper	4	8	4.30 (3.90)	1,043	0.14 (0.13)	1.4 (1.3)
	641-B Scrapper	[illegible]	8	23.15 (21.00)	1,043	1.11 (1.01)	11.6 (10.5)
	12-G Grader	[illegible]	8	4.30 (3.90)	1,043	0.03 (0.03)	0.4 (0.4)
Sub Total		[illegible]				15.82 (14.35)	164.8 (149.5)
TOTAL		[illegible]				60.73 (55.08)	683.5 (619.9)

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[illegible]

[a] Emissions [illegible] are relatively insignificant.

Table 4.1.2-32. HC motor vehicle emissions associated with DTN construction.

1	2	3	4	5	6	7	8
SEGMENT NUMBER	VEHICLE TYPE[a]	NUMBER OF VEHICLES	DISTANCE TRAVELED mi/day (km/day) OR OPERATING TIME hr/day	EMISSION FACTOR X 10^{-3} tons/mi (tonnes/km) OR tons/hr (tonnes/hr)	NUMBER OF CONSTRUCTION DAYS	EMISSIONS PER DAY X 10^{-3} tons (tonnes) (3.) x (4.) x (5.)	TOTAL EMISSIONS tons (tonnes) (3.) x (4.) x (5.) x (6.)
1	Spray Truck	1	20 (12)	0.50 (0.73)	586	0.02 (0.02)	0.1 (0.1)
	Semi	1	500 (311)	0.50 (0.73)	586	0.25 (0.23)	1.5 (1.4)
	Tank truck	3	500 (311)	0.50 (0.73)	586	0.75 (0.68)	4.4 (4.0)
	Water truck	171	160 (99)	0.50 (0.73)	586	13.60 (12.34)	79.7 (72.3)
	Carry all	3	20 (12)	0.39 (0.57)[b]	586	0.02 (0.02)	0.1 (0.1)
	30-ton truck	32	240 (149)	0.50 (0.73)	586	3.84 (3.48)	22.5 (20.4)
	Off road truck	39	8	21.85 (19.82)	586	6.82 (6.19)	39.9 (36.2)
	D-5 dozer	17	8	11.70 (10.61)	586	1.59 (1.44)	9.3 (8.4)
	12-G grader	44	8	2.70 (2.45)	586	0.95 (0.86)	5.6 (5.1)
	Backhoe	3	8	9.35 (8.48)	586	0.22 (0.20)	1.3 (1.2)
	641-B scraper	23	8	31.30 (28.39)	586	5.75 (5.22)	33.7 (30.6)
	Compactor	50	8	2.70 (2.45)	586	1.08 (0.98)	6.3 (5.7)
	Pipelayer	3	8	7.85 (7.12)	586	0.19 (0.17)	1.1 (1.0)
	Paver	4	8	2.70 (2.45)	586	0.09 (0.08)	0.5 (0.5)
	Roller	8	8	2.70 (2.45)	586	0.17 (0.15)	1.0 (0.9)
Sub-Total		401				35.35 (32.06)	207.0 (187.7)
2	Spray truck	1	20 (12)	0.50 (0.73)	564	0.02 (0.02)	0.1 (0.1)
	Semi	1	500 (311)	0.50 (0.73)	564	0.25 (0.23)	1.4 (1.3)
	Tank truck	3	500 (311)	0.50 (0.73)	564	0.75 (0.68)	4.2 (3.8)
	Water truck	130	160 (99)	0.50 (0.73)	564	10.40 (9.43)	58.7 (53.2)
	Carry all	3	20 (12)	0.39 (0.57)[b]	564	0.02 (0.02)	0.1 (0.1)
	30-ton truck	24	240 (149)	0.50 (0.73)	564	2.88 (2.61)	16.2 (14.7)
	Off road truck	31	8	21.85 (19.82)	564	5.42 (4.92)	30.6 (27.8)
	D-5 dozer	13	8	11.70 (10.61)	564	1.22 (1.11)	6.9 (6.3)
	12-G grader	34	8	2.70 (2.45)	564	0.73 (0.66)	4.1 (3.7)
	Backhoe	2	8	9.35 (8.48)	564	0.15 (0.14)	0.8 (0.7)
	641-B scraper	18	8	31.30 (28.39)	564	4.51 (4.09)	25.4 (23.0)
	Compactor	38	8	2.70 (2.45)	564	0.82 (0.74)	4.6 (4.2)
	Pipelayer	2	8	7.85 (7.12)	564	0.13 (0.12)	0.7 (0.6)
	Paver	3	8	2.70 (2.45)	564	0.06 (0.05)	0.4 (0.4)
	Roller	6	8	2.70 (2.45)	564	0.13 (0.12)	0.7 (0.6)
Sub-Total		310				27.49 (24.93)	154.9 (140.5)
3	Spray truck	1	20 (12)	0.50 (0.73)	586	0.02 (0.02)	0.1 (0.1)
	Semi	1	500 (311)	0.50 (0.73)	586	0.25 (0.23)	1.5 (1.4)
	Tank truck	3	500 (311)	0.50 (0.73)	586	0.75 (0.68)	4.4 (4.0)
	Water truck	149	160 (99)	0.50 (0.73)	586	11.92 (10.81)	69.9 (63.4)
	Carry all	3	20 (12)	0.39 (0.57)[b]	586	0.02 (0.02)	0.1 (0.1)
	30-ton truck	27	240 (149)	0.50 (0.73)	586	3.24 (2.94)	19.0 (17.2)
	Off road truck	34	8	21.85 (19.82)	586	5.94 (5.39)	34.8 (31.6)
	D-5 dozer	15	8	11.70 (10.61)	586	1.40 (1.27)	8.2 (7.4)
	12-G grader	39	8	2.70 (2.45)	586	0.84 (0.76)	4.9 (4.4)
	Backhoe	2	8	9.35 (8.48)	586	0.15 (0.14)	0.9 (0.8)
	641-B scraper	20	8	31.30 (28.39)	586	5.01 (4.54)	29.3 (26.6)
	Compactor	44	8	2.70 (2.45)	586	0.95 (0.86)	5.6 (5.1)
	Pipelayer	2	8	7.85 (7.12)	586	0.13 (0.12)	0.7 (0.6)
	Paver	3	8	2.70 (2.45)	586	0.06 (0.05)	0.4 (0.4)
	Roller	7	8	2.70 (2.45)	586	0.15 (0.14)	0.9 (0.8)
Sub-Total		351				30.83 (27.96)	180.7 (163.9)
4	Spray truck	1	20 (12)	0.50 (0.73)	500	0.02 (0.02)	0.1 (0.1)
	Semi	1	500 (311)	0.50 (0.73)	500	0.25 (0.23)	1.3 (1.2)
	Tank truck	3	500 (311)	0.50 (0.73)	500	0.75 (0.68)	3.8 (3.4)
	Water truck	158	160 (99)	0.50 (0.73)	500	12.64 (11.46)	63.2 (57.3)
	Carry all	3	20 (12)	0.39 (0.57)[b]	500	0.02 (0.02)	0.1 (0.1)
	30-ton truck	29	240 (149)	0.50 (0.73)	500	3.48 (3.16)	17.4 (15.8)
	Off road truck	36	8	21.85 (19.82)	500	6.29 (5.71)	31.5 (28.6)
	D-5 dozer	16	8	11.70 (10.61)	500	1.50 (1.36)	7.5 (6.8)
	12-G grader	41	8	2.70 (2.45)	500	0.89 (0.81)	4.4 (4.0)
	Backhoe	3	8	9.35 (8.48)	500	0.22 (0.20)	1.1 (1.0)
	641-B scraper	21	8	31.30 (28.39)	500	5.26 (4.77)	26.3 (23.9)
	Compactor	46	8	2.70 (2.45)	500	0.99 (0.90)	5.0 (4.5)
	Pipelayer	[illegible]	8	7.85 (7.12)	500	0.19 (0.17)	0.9 (0.8)
	Paver	4	8	2.70 (2.45)	500	0.09 (0.08)	0.4 (0.4)
	Roller	7	8	2.70 (2.45)	500	0.15 (0.14)	0.8 (0.7)
Sub-Total		[illegible]				32.74 (29.70)	163.8 (148.6)
Total		1,436				126.41 (114.65)	706.4 (640.7)

[a]All vehicles are diesel powered except carry-alls.

[b]Evaporative and crankcase hydrocarbon emission factors included.

Table 4.1.2-33. HC motor vehicle emissions associated with cluster road construction.

SEGMENT NO.	VEHICLE TYPE[a]	NO. OF VEHICLES	DIST. TRAVELED mi/day (km/day) OR OPERATING TIME hr/day	EMISSION FACTOR[b] tons/mi (tonnes/km) OR tons/hr (tonnes/hr)	NO. OF CONSTRUCTION DAYS	PER VEHICLE [illegible] tons (tonnes)	TOTAL EMISSIONS tons (tonnes)
	Semi	2	[illegible]	[illegible]	1,151	[illegible] 45)	
	Tank Truck	[illegible]	[illegible]	[illegible]	1,151	[illegible]	[illegible]
	Water Truck	[illegible]	160 (99)	3.50 (1.71)	1,151	[illegible]	[illegible]
	Carry All	[illegible]	[illegible]	[illegible]	1,151	[illegible]	
	Off Road Truck	[illegible]	8	21.45 (19.42)	1,151	[illegible]	[illegible]
	641-B Scraper	[illegible]	8	31.30 (28.39)	1,151	[illegible]	[illegible]
1	D-8 Dozer	[illegible]	8	11.77 (10.62)	1,151	[illegible]	[illegible]
	12-G Grader	[illegible]	8	2.73 (2.45)	1,151	[illegible]	[illegible]
	Backhoe		8	9.35 (8.48)	1,151	[illegible]	[illegible]
	Spreader	[illegible]	8	2.73 (2.45)	1,151	[illegible]	[illegible]
	Compactor	[illegible]	8	2.73 (2.45)	1,151	[illegible]	[illegible]
	Pipelayer		8	7.85 (7.12)	1,151	[illegible]	[illegible]
Subtotal		[illegible]				[illegible]	[illegible]
	Semi	2	[illegible]	[illegible]	434	[illegible]	[illegible]
	Tank Truck	[illegible]	[illegible]	[illegible]	434	[illegible]	[illegible]
	Water Truck	[illegible]	160 (99)	[illegible]	434	[illegible]	[illegible]
	Carry All	4	[illegible]	[illegible]	434	[illegible]	[illegible]
	Off Road Truck	[illegible]	8	21.45 (19.42)	434	[illegible]	[illegible]
	641-B Scraper	[illegible]	8	[illegible]	434	[illegible]	[illegible]
2	D-8 Dozer	[illegible]	8	[illegible]	434	[illegible]	[illegible]
	12-G Grader		8	[illegible]	434	[illegible]	[illegible]
	Backhoe	4	8	[illegible]	434	[illegible]	[illegible]
	Spreader	[illegible]	8	[illegible]	434	[illegible]	[illegible]
	Compactor	[illegible]	8	[illegible]	434	[illegible]	[illegible]
	Pipelayer	4	8	7.85 (7.12)	434	[illegible]	[illegible]
Subtotal		[illegible]				[illegible]	[illegible] 254.6)
	Semi	2	[illegible]	[illegible]	426	[illegible]	[illegible]
	Tank Truck	[illegible]	[illegible]	[illegible]	426	[illegible]	[illegible]
	Water Truck	204	[illegible]	[illegible]	426	[illegible] 14.90)	134.8 [illegible]
	Carry All	[illegible]	[illegible]	[illegible]	426	[illegible]	[illegible]
	Off Road Truck	[illegible]	8	21.45 (19.42)	426	[illegible]	92.4 [illegible]
	641-B Scraper	[illegible]	8	[illegible] (28.39)	426	[illegible]	14.3 [illegible]
3	D-8 Dozer	[illegible]	8	[illegible]	426	[illegible]	[illegible]
	12-G Grader	[illegible]	8	2.73 (2.45)	426	[illegible]	[illegible]
	Backhoe	4	8	9.35 (8.48)	426	[illegible]	[illegible]
	Spreader	[illegible]	8	2.73 (2.45)	426	[illegible]	[illegible]
	Compactor	[illegible]	8	2.70 (2.45)	426	[illegible]	[illegible]
	Pipelayer	4	8	7.85 (7.12)	426	[illegible]	[illegible]
Subtotal		[illegible]				[illegible]	[illegible]
	Semi	[illegible]	[illegible]	[illegible]	456	[illegible]	[illegible]
	Tank Truck	[illegible]	[illegible]	[illegible]	456	[illegible]	[illegible]
	Water Truck	216	160 (99)	3.50 (1.71)	456	[illegible]	[illegible]
	Carry All	[illegible]	[illegible]	[illegible]	456	[illegible]	[illegible]
	Off Road Truck	[illegible]	8	21.45 (19.42)	456	[illegible]	[illegible]
4	641-B Scraper	[illegible]	8	31.30 (28.39)	456	[illegible]	[illegible]
	D-8 Dozer	[illegible]	8	[illegible]	456	[illegible]	[illegible]
	12-G Grader	[illegible]	8	[illegible] (2.45)	456	[illegible]	[illegible]
	Backhoe	4	8	[illegible] (8.45)	456	[illegible]	[illegible]
	Spreader	[illegible]	8	[illegible] (2.45)	456	[illegible]	[illegible]
	Compactor	[illegible]	8	[illegible]	456	[illegible]	[illegible]
	Pipelayer	4	8	[illegible]	456	[illegible]	[illegible]
Subtotal		417				[illegible]	[illegible]
TOTAL		[illegible]				[illegible]	[illegible]

[a] All vehicles are diesel powered except carry-alls.
[b] [illegible]

Table 4.1.2-34. HC motor vehicle emissions associated with shelter construction.

[illegible] SEGMENT NUMBER	[illegible] VEHICLE TYPE	NUMBER OF VEHICLES	4 DISTANCE TRAVELED mi/day (km/day) OR OPERATING TIME hr/day	[illegible] EMISSION FACTOR x [illegible] tons/mi (tonnes/km) OR tons/hr (tonnes/hr)	6 NUMBER OF CONSTRUCTION DAYS	[illegible] EMISSIONS PER DAY x 10^-2 tons (tonnes) [illegible] x (4) x [illegible]	8 TOTAL EMISSIONS tons (tonnes) (3) x (4) x (5) x [illegible]
[illegible]	[illegible] truck		50[illegible] (311)	[illegible] ([illegible])	1239	0.75 (0.68)	9.3 (8.3)
	Concrete truck	[illegible]	150 (93)	[illegible].5 ([illegible].73)	1234	3.75 (3.40)	46.5 (42.2)
	Semi	[illegible]	50[illegible] (311)	[illegible] ([illegible])	1239	[illegible].50 (0.45)	6.2 (5.6)
	Water truck	224	16[illegible] ([illegible])	[illegible].59 ([illegible])	1239	17.92 (16.25)	22[illegible] (201.4)
	Carry all	[illegible]	[illegible] (12)	[illegible].34 ([illegible].57)	1234	[illegible].02 ([illegible].02)	0.3 (0.3)
	Flatbed truck	12	2[illegible] (12)	.5[illegible] ([illegible].73)	1234	0.11 (0.11)	1.5 (1.4)
	[illegible] dozer	[illegible]	[illegible]	11.7[illegible] ([illegible])	1234	[illegible].94 (0.85)	11.6 (10.5)
	Compactor		[illegible]	[illegible].70 ([illegible].45)	1239	0.06 (0.05)	0.6 ([illegible])
	[illegible] w ripper	4	[illegible]	[illegible].70 ([illegible].45)	1234	[illegible].09 (0.08)	1.1 ([illegible])
	[illegible]41-B scraper	[illegible]	[illegible]	31.3[illegible] (2[illegible].39)	123[illegible]	1.50 (1.36)	18.6 (16.9)
	[illegible] grader	[illegible]	[illegible]	[illegible].70 ([illegible].45)	1239	0.04 (0.04)	0.5 ([illegible])
Sub-total		31[illegible]				25.69 (23.30)	318.4 (288.[illegible])
[illegible]	[illegible] truck		5[illegible] (311)	0.5[illegible] ([illegible].73)	1173	0.75 (0.68)	8.[illegible] (8.[illegible])
	Concrete truck	[illegible]	150 (93)	[illegible].5[illegible] ([illegible].73)	1173	2.93 (2.66)	34.3 (31.1)
	Semi	[illegible]	5[illegible] (311)	[illegible].5[illegible] ([illegible].73)	117[illegible]	[illegible].25 (0.23)	2.9 (2.6)
	Water truck	[illegible]	16[illegible] (99)	[illegible].5[illegible] ([illegible].73)	1173	13.68 (12.41)	16[illegible].5 (145.6)
	Carry all	[illegible]	2[illegible] (12)	[illegible].34 ([illegible].57)	117[illegible]	[illegible].02 ([illegible].02)	0.2 ([illegible].2)
	Flatbed truck	[illegible]	2[illegible] (12)	[illegible].59 ([illegible].73)	1173	0.10 (0.09)	1.2 (1.1)
	[illegible] dozer	[illegible]	[illegible]	11.7[illegible] (1[illegible].61)	1173	[illegible].66 ([illegible].60)	[illegible] ([illegible])
	Compactor		[illegible]	[illegible].70 ([illegible].45)	117[illegible]	0.04 (0.04)	[illegible].5 ([illegible].5)
	[illegible] w ripper	4	[illegible]	[illegible].70 ([illegible].45)	1173	[illegible].0[illegible] ([illegible].08)	1.[illegible] (0.[illegible])
	[illegible]41-B scraper	[illegible]	[illegible]	31.3[illegible] (28.39)	1173	1.25 (1.13)	14.7 (13.3)
	[illegible] grader	[illegible]	[illegible]	[illegible].70 ([illegible].45)	117[illegible]	[illegible].02 (0.02)	0.3 (0.3)
Sub-total		24[illegible]				19.7[illegible] (17.95)	302.1 (274.0)
[illegible]	[illegible] truck	[illegible]	500 (311)	0.5[illegible] ([illegible].73)	1043	[illegible].75 (0.68)	7.6 (7.1)
	Concrete truck	44	150 (93)	0.5[illegible] ([illegible].73)	1043	3.3[illegible] (2.99)	34.4 (31.2)
	Semi	[illegible]	50[illegible] (311)	0.5[illegible] ([illegible].73)	1043	[illegible].25 (0.23)	2.6 (2.4)
	Water truck	19[illegible]	16[illegible] (99)	[illegible] ([illegible].73)	104[illegible]	15.6[illegible] (14.22)	1[illegible]3.5 (146.3)
	Carry all	[illegible]	2[illegible] (12)	[illegible].39 ([illegible].57)	1043	[illegible].02 (0.02)	0.2 (0.2)
	Flatbed truck	1[illegible]	2[illegible] (12)	[illegible].5[illegible] ([illegible].73)	1043	[illegible].11 ([illegible].10)	1.1 (1.[illegible])
	[illegible] dozer	[illegible]	[illegible]	11.7[illegible] (1[illegible].61)	1043	0.7[illegible] ([illegible].66)	7.6 (7.1)
	Compactor	[illegible]	[illegible]	[illegible].70 ([illegible].45)	104[illegible]	0.04 (0.04)	0.5 ([illegible].5)
	[illegible] w ripper	4	[illegible]	[illegible].7[illegible] ([illegible].45)	104[illegible]	[illegible].09 (0.08)	0.9 ([illegible].8)
	[illegible]41-B scraper	[illegible]	[illegible]	31.30 (28.39)	104[illegible]	1.25 (1.13)	13.1 (11.9)
	[illegible] grader	[illegible]	[illegible]	[illegible].70 ([illegible].45)	104[illegible]	[illegible].02 (0.02)	0.2 ([illegible].2)
Sub-total		[illegible]				[illegible].28 (20.19)	23[illegible].1 (21[illegible].5)
[illegible]	[illegible] truck		50[illegible] (311)	[illegible].5[illegible] ([illegible].73)	104[illegible]	0.75 (0.68)	7.6 (7.1)
	Concrete truck	47	15[illegible] ([illegible])	[illegible].5[illegible] ([illegible].73)	1043	3.53 (3.2[illegible])	36.8 (33.4)
	Semi	[illegible]	5[illegible] (311)	[illegible].5[illegible] ([illegible].73)	1043	[illegible].25 (0.23)	2.6 (2.4)
	Water truck	[illegible]	1[illegible] ([illegible])	0.5[illegible] ([illegible].73)	1043	16.64 (15.29)	173.6 (157.5)
	Carry all	[illegible]	2[illegible] (12)	[illegible].39 ([illegible].57)	104[illegible]	[illegible].02 ([illegible].02)	0.2 ([illegible].2)
	Flatbed truck	1[illegible]	2[illegible] (12)	[illegible].5[illegible] ([illegible].73)	104[illegible]	[illegible].11 ([illegible].10)	1.1 (1.[illegible])
	[illegible] dozer	[illegible]	[illegible]	11.7[illegible] (1[illegible].61)	1043	[illegible].84 ([illegible].7[illegible])	8.8 (8.0)
	Compactor	[illegible]	[illegible]	[illegible].70 ([illegible].45)	1043	[illegible].0[illegible] (0.05)	[illegible].7 ([illegible].6)
	[illegible] w ripper	4	[illegible]	[illegible].7[illegible] ([illegible].45)	1043	[illegible].09 ([illegible].08)	[illegible] (0.8)
	[illegible]41-B scraper	[illegible]	[illegible]	31.3[illegible] (28.39)	1043	1.5[illegible] (1.36)	15.7 (14.2)
	[illegible] grader	[illegible]	[illegible]	[illegible].70 ([illegible].45)	1043	[illegible].02 ([illegible].02)	0.2 ([illegible].2)
Sub-total		[illegible]				2[illegible].81 (21.6[illegible])	24[illegible].4 (221.[illegible])
Total		[illegible]				9[illegible] (8[illegible].04)	1,[illegible] (9[illegible].6)

All vehicles are diesel powered except carry-alls [illegible]

[illegible] and truck [illegible] carbon emission factors included

Table 4.1.2-35. Construction particulate emissions and emission rates for Nevada/Utah deployment area - mobile sources.

SEGMENT No.	CLUSTER No.	SHELTER CONSTRUCTION			CLUSTER ROAD CONSTRUCTION			DTN CONSTRUCTION		
		CONSTRUCTION TIME PERIOD (Number of Working Days)	TOTAL EMISSIONS tons (tonnes)[1]	EMISSION RATE tons/day (tonnes/day)	CONSTRUCTION TIME PERIOD (Number of Working Days)	TOTAL EMISSIONS tons (tonnes)	EMISSION RATE tons/day (tonnes/day)	CONSTRUCTION TIME PERIOD (Number of Working Days)	TOTAL EMISSIONS tons (tonnes)	EMISSION RATE tons/day (tonnes/day)
1	11	10/84-11/85 (282)	25.8 (23.4)	0.1 (0.1)	6/84- 4/85 (216)	45.6 (41.4)	0.2 (0.2)	1/84- 6/84 (105)	20.7 (18.8)	0.2 (0.2)
	4	6/85-11/86 (369)	33.[illegible] (30.6)	0.1 (0.1)	4/85- 4/86 (261)	55.1 (50.0)	0.2 (0.2)	6/84-12/84 (136)	26.8 (24.3)	0.2 (0.2)
	5	7/86- 8/87 (282)	25.8 (23.4)	0.1 (0.1)	4/86- 1/87 (195)	41.2 (37.4)	0.2 (0.2)	12/84- 4/85 (94)	18.5 (16.8)	0.2 (0.2)
	6	5/87- 6/88 (282)	25.8 (23.4)	0.1 (0.1)	1/87-11/87 (216)	45.6 (41.4)	0.2 (0.2)	4/85-10/85 (115)	22.7 (20.6)	0.2 (0.2)
	12	9/88- 7/89 (347)	31.7 (28.8)	0.1 (0.1)	11/87-11/88 (261)	55.1 (50.0)	0.2 (0.2)	10/85- 4/86 (136)	26.8 (24.3)	0.2 (0.2)
2	1	1/85-11/86 (477)	37.4 (34.0)	0.1 (0.1)	10/84- 4/86 (391)	68.4 (62.0)	0.2 (0.2)	5/84- 3/85 (210)	31.9 (28.9)	0.2 (0.1)
	2	8/86- 2/88 (391)	30.7 (27.8)	0.1 (0.1)	4/86- 6/87 (304)	53.2 (48.2)	0.2 (0.2)	3/85-10/85 (157)	23.9 (21.6)	0.2 (0.1)
	3	10/87- 7/89 (456)	35.8 (32.5)	0.1 (0.1)	6/87- 5/88 (239)	41.8 (37.9)	0.2 (0.2)	10/85- 7/86 (197)	29.9 (27.2)	0.2 (0.1)
3	9	7/85- 1/87 (391)	31.3 (28.4)	0.1 (0.1)	3/85- 5/86 (304)	48.8 (44.3)	0.2 (0.1)	10/84- 6/85 (179)	24.0 (21.8)	0.1 (0.1)
	10	9/86-11/87 (304)	24.3 (22.1)	0.1 (0.1)	5/86- 4/87 (239)	38.4 (34.8)	0.2 (0.1)	6/85- 1/86 (144)	19.3 (17.5)	0.1 (0.1)
	8	7/87-10/88 (326)	26.1 (23.6)	0.1 (0.1)	4/87- 2/88 (216)	34.7 (31.5)	0.2 (0.1)	1/86- 7/86 (132)	17.7 (16.1)	0.1 (0.1)
	7	6/88- 7/89 (282)	22.6 (20.5)	0.1 (0.1)	2/88- 2/89 (261)	41.9 (38.0)	0.2 (0.1)	7/86- 1/87 (132)	17.7 (16.1)	0.1 (0.1)
4	16	7/85- 9/86 (304)	26.2 (23.7)	0.1 (0.1)	3/85- 1/86 (216)	45.5 (41.2)	0.2 (0.2)	10/84- 3/85 (115)	21.0 (19.0)	0.2 (0.2)
	15	5/86- 9/87 (347)	29.9 (27.1)	0.1 (0.1)	1/86- 1/87 (261)	54.9 (49.8)	0.2 (0.2)	3/85- 9/85 (134)	24.4 (22.2)	0.2 (0.2)
	14	5/87- 8/88 (326)	28.1 (25.5)	0.1 (0.1)	1/87-12/87 (239)	50.3 (45.6)	0.2 (0.2)	9/85- 3/86 (125)	22.8 (20.7)	0.2 (0.2)
	13	4/88- 7/89 (326)	28.1 (25.5)	0.1 (0.1)	12/87-11/88 (239)	50.3 (45.6)	0.2 (0.2)	3/86- 9/86 (125)	22.8 (20.7)	0.2 (0.2)

[1] tonne = 1 metric ton = 1000 kg = 2205 lb.

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Table 4.1.2-36. Construction NO_x emissions and emission rates for Nevada/Utah deployment area - mobile sources.

Segment No.	Group No.	DTN Construction			Shelter Construction			Cluster Road Construction		
		Construction Time Period (No. Working Days)	Total Emissions Tons (Tonnes)	Emission Rate Tons/Day (Tonnes/Day)	Construction Time Period (No. Working Days)	Total Emissions Tons (Tonnes)	Emission Rate Tons/Day (Tonnes/Day)	Construction Time Period (No. Working Days)	Total Emissions Tons (Tonnes)	Emission Rate Tons/Day (Tonnes/Day) Days)
1	11	1/84-6/84 (105)	354.2 (321.3)	3.4 (3.1)	10/84-11/85 (282)	301.5 (273.5)	1.1 (1.0)	6/84-4/85 (216)	872.0 (790.9)	4.0 (3.7)
	4	6/84-12/84 (136)	458.8 (416.1)	3.4 (3.1)	6/85-11/86 (369)	394.5 (357.9)	1.1 (1.0)	4/85-4/86 (261)	1,053.7 (955.7)	4.0 (3.7)
	5	12/84-4/85 (94)	317.1 (287.6)	3.4 (3.1)	7/86-8/87 (282)	301.5 (273.5)	1.1 (1.0)	4/86-1/87 (195)	787.2 (714.0)	4.0 (3.7)
	6	4/85-10/85 (115)	387.9 (351.9)	3.4 (3.1)	5/87-6/88 (282)	301.5 (273.5)	1.1 (1.0)	1/87-11/87 (216)	872.0 (790.0)	4.0 (3.7)
	12	10/85-4/86 (136)	458.8 (416.1)	3.4 (3.1)	3/88-7/89 (347)	371.0 (336.5)	1.1 (1.0)	11/87-11/88 (261)	1,053.7 (955.7)	4.0 (3.7)
2	1	5/84-3/85 (210)	549.8 (498.7)	2.6 (2.4)	1/85-11/86 (477)	435.4 (394.9)	0.9 (0.8)	10/84-4/86 (391)	1,218.6 (1,105.3)	3.1 (2.8)
	2	3/85-10/85 (157)	411.1 (372.8)	2.6 (2.4)	8/86-2/88 (391)	356.9 (323.7)	0.9 (0.8)	4/86-6/87 (304)	947.5 (859.4)	3.1 (2.8)
	3	10/85-7/86 (197)	515.8 (467.8)	2.6 (2.4)	10/87-7/89 (456)	416.3 (377.5)	0.9 (0.8)	6/87-5/88 (239)	744.9 (675.6)	3.1 (2.8)
3	9	10/84-6/85 (179)	524.1 (475.3)	2.9 (2.7)	7/85-1/87 (391)	361.5 (327.8)	0.9 (0.8)	3/85-5/86 (304)	870.4 (789.4)	2.9 (2.6)
	10	6/85-1/86 (144)	421.6 (382.4)	2.9 (2.7)	9/86-11/87 (304)	281.0 (254.9)	0.9 (0.8)	5/86-4/87 (239)	684.3 (620.6)	2.9 (2.6)
	8	1/86-7-86 (132)	386.5 (350.5)	2.9 (2.7)	7/87-10/88 (326)	301.4 (273.3)	0.8 (0.8)	4/87-2/88 (216)	618.4 (560.9)	2.9 (2.6)
	7	7/86-1/87 (132)	386.5 (350.5)	2.9 (2.7)	6/88-7/89 (282)	260.7 (236.4)	0.9 (0.8)	2/88-2/99 (261)	747.3 (677.8)	2.9 (2.6)
4	16	10/84-3/85 (115)	359.6 (326.1)	3.1 (2.8)	7/85-9/86 (304)	305.7 (277.3)	1.0 (0.9)	3/85-1/86 (216)	808.6 (733.4)	3.7 (3.4)
	15	3/85-9/85 (134)	419.0 (380.0)	3.1 (2.8)	5/86-9/87 (347)	348.9 (316.5)	1.0 (0.9)	1/86-1/87 (261)	977.0 (866.1)	3.7 (3.4)
	14	9/85-3/86 (125)	390.8 (354.5)	3.1 (2.8)	5/87-8/88 (326)	327.8 (297.3)	1.0 (0.9)	1/87-12/87 (239)	894.7 (811.5)	3.7 (3.4)
	13	3/86-9/86 (125)	390.8 (354.5)	3.1 (2.8)	4/88-7/89 (326)	327.8 (297.3)	1.0 (0.9)	12/87-11/88 (239)	894.7 (811.5)	3.7 (3.4)

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Table 4.1.2-37. Construction CO emissions and emission rates for Nevada/Utah deployment area - mobile sources.

SEGMENT NO.	GROUP NO.	SHELTER CONSTRUCTION			CLUSTER ROAD CONSTRUCTION			DTN CONSTRUCTION		
		CONSTRUCTION TIME PERIOD (Number of Working Days)	TOTAL EMISSIONS tons (tonnes)	EMISSION RATE tons/day (tonnes/day)	CONSTRUCTION TIME PERIOD (Number of Working Days)	TOTAL EMISSIONS tons (tonnes)	EMISSION RATE tons/day (tonnes/day)	CONSTRUCTION TIME PERIOD (Number of Working Days)	TOTAL EMISSIONS tons (tonnes)	EMISSION RATE tons/day (tonnes/day)
	11	10/84-11/85 (282)	308.5 (279.8)	1.1 (1.0)	6/84 - 4/85 (216)	368.6 (334.5)	1.7 (1.5)	1/84- 6/84 (105)	161.3 (146.3)	1.5 (1.4)
	4	6/85-11/86 (369)	403.7 (366.2)	1.1 (1.0)	4/85- 4/86 (261)	445.6 (404.2)	1.7 (1.5)	6/84-12/84 (136)	209.0 (189.5)	1.5 (1.4)
1	5	7/86- 8/87 (282)	308.5 (279.8)	1.1 (1.0)	4/86- 1/87 (195)	330.0 (302.0)	1.7 (1.5)	12/84- 4/85 (94)	144.4 (131.0)	1.5 (1.4)
	6	5/87- 6/88 (282)	308.5 (279.8)	1.1 (1.0)	1/87-11/87 (216)	368.6 (334.5)	1.7 (1.5)	4/85-10/85 (115)	176.7 (160.3)	1.5 (1.4)
	12	3/88- 7/89 (347)	379.6 (344.3)	1.1 (1.0)	11/87-11/88 (261)	445.6 (404.2)	1.7 (1.5)	10/85- 4/86 (136)	209.0 (189.5)	1.5 (1.4)
	1	1/85-11/86 (477)	447.1 (405.5)	0.9 (0.9)	10/84- 4/86 (391)	505.1 (458.1)	1.3 (1.2)	5/84- 3/85 (210)	253.1 (229.6)	1.2 (1.1)
2	2	8/86- 2/88 (391)	366.5 (332.4)	0.9 (0.9)	4/86- 6/87 (304)	392.7 (356.2)	1.3 (1.2)	3/85-10/85 (157)	189.3 (171.7)	1.2 (1.1)
	3	10/87- 7/89 (456)	427.4 (387.6)	0.9 (0.9)	6/87- 5/88 (239)	308.7 (280.0)	1.3 (1.2)	10/85- 7/86 (197)	237.5 (215.4)	1.2 (1.1)
	9	7/85- 1/87 (391)	386.5 (350.6)	1.0 (0.9)	3/85- 5/86 (304)	456.9 (414.4)	1.5 (1.4)	10/84- 6/85 (179)	236.6 (216.6)	1.3 (1.2)
	10	9/86-11/87 (304)	300.5 (272.6)	1.0 (0.9)	5/86- 4/87 (239)	359.2 (325.8)	1.5 (1.4)	6/85- 1/86 (144)	192.1 (174.3)	1.3 (1.2)
3	8	7/87-10/88 (326)	322.3 (292.3)	1.0 (0.9)	4/87- 2/88 (216)	324.7 (294.5)	1.5 (1.4)	1/86- 7/86 (132)	176.1 (159.7)	1.3 (1.3)
	7	6/88- 7/89 (282)	278.8 (252.8)	1.0 (0.9)	2/88- 2/89 (261)	392.3 (355.8)	1.5 (1.4)	7/86- 1/87 (132)	176.1 (159.7)	1.3 (1.2)
	16	7/85- 9/86 (304)	326.9 (296.5)	1.1 (1.0)	3/85- 1/86 (216)	357.7 (324.5)	1.7 (1.5)	10/84- 3/85 (115)	163.7 (148.5)	1.4 (1.3)
	15	5/86- 9/87 (347)	373.2 (338.5	1.1 (1.0)	1/86- 1/87 (261)	432.3 (392.1)	1.7 (1.5)	3/85- 9/85 (134)	190.8 (173.0)	1.4 (1.3)
4	14	5/87- 8/88 (326)	350.6 (318.0)	1.1 (1.0)	1/87-12/87 (239)	395.6 (359.0)	1.7 (1.5)	9/85- 3/86 (125)	178.0 (161.4)	1.4 (1.3)
	13	4/88- 7/89 (326)	350.6 (318.0)	1.1 (1.0)	12/87-11/88 (239)	395.6 (359.0)	1.7 (1.5)	3/86- 9/86 (125)	178.0 (161.4)	1.4 (1.3)

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Table 4.1.2-38. Construction SO_x emissions and emission rates for Nevada/Utah deployment area - mobile sources.

SEGMENT NO.	GROUP NO.	SHELTER CONSTRUCTION: CONSTRUCTION TIME PERIOD (Number of Working Days)	SHELTER CONSTRUCTION: TOTAL EMISSIONS tons (tonnes)	SHELTER CONSTRUCTION: EMISSION RATE tons/day (tonnes/day)	CLUSTER ROAD CONSTRUCTION: CONSTRUCTION TIME PERIOD (Number of Working Days)	CLUSTER ROAD CONSTRUCTION: TOTAL EMISSIONS tons (tonnes)	CLUSTER ROAD CONSTRUCTION: EMISSION RATE tons/day (tonnes/day)	DTN CONSTRUCTION: CONSTRUCTION TIME PERIOD (Number of Working Days)	DTN CONSTRUCTION: TOTAL EMISSIONS tons (tonnes)	DTN CONSTRUCTION: EMISSION RATE tons/day (tonnes/day)
[illegible]	[illegible]	[illegible] ([illegible])	36.[illegible] (33.2)	[illegible] (0.1)	6/84- 4/85 (216)	68.9 (62.5)	0.3 (0.3)	1/84- 6/84 (105)	29.6 (26.8)	0.3 (0.3)
	[illegible]	[illegible]/85-11/8[illegible] (369)	47.[illegible] (4[illegible].4)	0.1 (0.1)	4/85-4/86 (261)	83.3 (75.5)	0.3 (0.3)	6/84-12/84 (136)	38.3 (34.7)	0.3 (0.3)
	[illegible]	[illegible] ([illegible])	36.[illegible] (33.2)	[illegible] (0.1)	4/86- 1/87 (195)	62.[illegible] (56.4)	0.3 (0.3)	12/84- 4/85 (94)	26.5 (24.0)	0.3 (0.3)
	[illegible]	5/87- [illegible] (282)	36.6 (33.2)	0.1 (0.1)	1/87-11/87 (216)	68.9 (62.5)	0.3 (0.3)	4/85-10/85 (115)	32.4 (29.4)	0.3 (0.3)
	[illegible]	3/88- [illegible] (347)	45.[illegible] (4[illegible].9)	0.1 (0.1)	11/87-11/88 (261)	83.3 (75.5)	0.3 (0.3)	10/85- 4/86 (136)	38.3 (34.7)	0.3 (0.3)
[illegible]	[illegible]	[illegible]/85-11/86 (477)	53.[illegible] (48.[illegible])	[illegible] (0.1)	10/84- 4/86 (391)	147.0 (133.3)	0.4 (0.3)	5/84- 3/85 (210)	45.7 (41.5)	0.2 (0.2)
	[illegible]	[illegible] (391)	43.4 (39.4)	[illegible]	4/86-6/87 (304)	114.3 (103.6)	0.4 (0.3)	3/85-10/85 (157)	34.2 (31.0)	0.2 (0.2)
	[illegible]	10/87- 7/89 (456)	[illegible] (45.9)	[illegible]	6/87- 5/88 (239)	89.8 (81.5)	0.4 (0.3)	10/85- 7/86 (197)	42.9 (38.9)	0.2 (0.2)
[illegible]	[illegible]	7/85- [illegible] (391)	4[illegible] (4[illegible])	[illegible]	3/85- 5/86 (304)	68.8 (63.4)	0.2 (0.2)	10/84- 6/85 (179)	43.8 (39.7)	0.2 (0.2)
	[illegible]	9/86-11/8[illegible] (3[illegible]4)	34.4 ([illegible])	[illegible]	5/86- 4/87 (239)	54.1 (49.0)	0.2 (0.2)	6/85- 1/86 (144)	35.2 (31.9)	0.2 (0.2)
	[illegible]	7/8[illegible]-1[illegible]/88 (32[illegible])	[illegible]	[illegible]	4/87- 2/88 (21[illegible])	48.9 (44.3)	0.2 (0.2)	1/85- 7/86 (132)	32.3 (29.3)	0.2 (0.2)
	[illegible]	[illegible]/88- 7/8[illegible] (262)	[illegible]	[illegible] (0.1)	2/88- 2/89 (2[illegible])	59.[illegible] (53.5)	0.2 (0.2)	7/86- 1/87 (132)	32.3 (29.3)	0.2 (0.2)
4	[illegible]	7/85- [illegible] ([illegible])	3[illegible] (33.[illegible])	0.1 (0.1)	3/85- 1/86 (21[illegible])	64.[illegible] (58.0)	0.3 (0.3)	10/84- 3/85 (115)	30.0 (27.2)	0.3 (0.2)
	[illegible]	5/86- [illegible] (347)	4[illegible] (36.4)	[illegible] (0.1)	1/86- 1/87 (261)	77.3 (70.1)	[illegible] (0.3)	3/85- 9/85 (134)	35.0 (31.7)	0.3 (0.2)
	[illegible]	[illegible] (32[illegible])	3[illegible] (36.[illegible])	[illegible] (0.1)	1/87-12/87 (239)	7[illegible].8 (64.2)	[illegible] (0.3)	4/85- 3/86 (125)	32.[illegible] (29.6)	[illegible] (0.2)
	[illegible]	4/88- [illegible] (32[illegible])	3[illegible] (3[illegible])	0.1 (0.1)	12/87-11/88 (23[illegible])	7[illegible] (64.2)	[illegible] (0.3)	3/86- 9/86 (125)	32.6 (29.6)	0.2 (0.2)

Table 4.1.2-39. Construction hydrocarbon emissions and emission rates for Nevada/Utah deployment area - mobile sources.

SEGMENT NO.	GROUP NO.	SHELTER CONSTRUCTION			CLUSTER ROAD CONSTRUCTION			DTN CONSTRUCTION		
		CONSTRUCTION TIME PERIOD (Number of Working Days)	TOTAL EMISSIONS tons (tonnes)	EMISSION RATE tons/day (tonnes/day)	CONSTRUCTION TIME PERIOD (Number of Working Days)	TOTAL EMISSIONS tons (tonnes)	EMISSION RATE tons/day (tonnes/day)	CONSTRUCTION TIME PERIOD (Number of Working Days)	TOTAL EMISSIONS tons (tonnes)	EMISSION RATE tons/day (tonnes/day)
	11	10/84-11/85 (282)	54.9 (49.8)	0.2 (0.2)	6/84 - 4/85 (216)	81.5 (73.9)	0.4 (0.3)	1/84- 6/84 (105)	36.1 (32.8)	0.3 (0.3)
	4	6/85-11/86 (369)	71.8 (65.2)	0.2 (0.2)	4/85- 4/86 (261)	98.4 (89.3)	0.4 (0.3)	6/84-12/84 (136)	46.8 (42.4)	0.3 (0.3)
1	5	7/86- 6/87 (282)	54.9 (49.8)	[illegible] (0.2)	4/86- 1/87 (195)	73.5 (66.7)	0.4 (0.3)	12/84- 4/85 (94)	32.3 (29.3)	0.3 (0.3)
	6	5/87- 6/88 (282)	54.9 (49.8)	0.2 (0.2)	1/87-11/87 (216)	81.5 (73.9)	0.4 (0.[illegible]	4/85-10/85 (115)	39.6 (35.9)	0.3 (0.3)
	12	5/88- 7/89 (347)	67.6 (61.3)	0.2 (0.2)	11/87-11/88 (261)	98.4 (89.3)	0.4 (0.3)	10/85- 4/86 (136)	46.8 (42.4)	0.3 (0.3)
	1	1/85-11/86 (477)	105.0 (95.2)	0.2 (0.2)	10/84- 4/86 (391)	113.9 (103.3)	0.3 (0.3)	5/84- 3/85 (210)	55.8 (50.6)	0.2 (0.2)
2	2	8/86- 2/88 (391)	86.0 (78.0)	0.2 (0.2)	4/86- 6/87 (304)	88.6 (80.3)	0.3 (0.3)	3/85-10/85 (157)	41.7 (34.8)	0.3 (0.2)
	3	10/87- 7/89 (456)	100.3 (91.0)	0.2 (0.2)	6/87- 5/88 (239)	69.6 (63.2)	0.3 (0.3)	10/85- 7/86 (197)	52.3 (47.4)	0.3 (0.2)
	9	7/85- 1/87 (392)	66.8 (60.6)	0.2 (0.2)	3/85- 5/86 (304)	81.3 (73.7)	0.3 (0.2)	10/84- 6/85 (179)	53.4 (48.5)	0.3 (0.3)
	10	9/86-11/87 (304)	51.9 (47.1)	0.2 (0.2)	5/86- 4/87 (239)	63.9 (57.9)	0.3 (0.2)	6/85- 1/86 (144)	43.0 (39.0)	0.3 (0.3)
3	8	7/87-10/88 (326)	55.7 (50.5)	0.2 (0.2)	4/87- 2/88 (216)	57.7 (52.4)	0.3 (0.2)	1/86- 7/86 (132)	39.4 (35.7)	0.3 (0.3)
	7	6/88- 7/89 (282)	48.2 (43.7)	0.2 (0.2)	2/88- 2/89 (261)	69.6 (63.3)	0.3 (0.2)	7/86- 1/87 (132)	39.4 (35.7)	0.3 (0.3)
	16	7/85- 9/86 (304)	55.7 (50.5)	0.2 (0.2)	3/85- 1/86 (216)	75.6 (68.6)	0.4 (0.3)	10/84- 3/85 (115)	36.7 (33.3)	0.3 (0.3)
	15	5/86- 9/87 (347)	63.6 (57.7)	0.2 (0.2)	1/86- 1/87 (261)	91.4 (82.9)	0.4 (0.3)	3/85- 9/85 (134)	42.7 (38.8)	0.3 (0.3)
4	14	5/87- 8/88 (326)	59.8 (54.2)	[illegible] (0.2)	1/87-12/87 (239)	83.7 (75.9)	0.4 (0.3)	9/85- 3/86 (125)	39.9 (36.2)	0.3 (0.3)
	13	4/88- 7/89 (326)	59.8 (54.2)	0.2 (0.2)	12/87-11/88 (239)	83.7 (75.9)	0.4 (0.3)	3/86- 9/86 (125)	39.9 (36.2)	0.3 (0.3)

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Table 4.1.2-40. Bituminous surfacing material for DTN construction power generator emissions from sand and gravel processing and stone quarrying and processing plants.

SEGMENT NUMBER	GROUP NUMBER	NUMBER OF CONSTRUCTION DAYS	TOTAL CUBIC YARDS OF BITUMINOUS SURFACING MATERIAL (E + 05)	TOTAL GALLONS OF FUEL (E + 05)	EMISSIONS TOTAL EMISSIONS TONS (TONNES) DAILY EMISSION RATE TONS/DAY (TONNES/DAY)					
					CO	HC	NO_x	ALDEHYDES	SO_x	TSP
	[illegible]	105	1.823	0.406	2.1 (1.9) 0.020 (0.018)	0.8 (0.7) 0.007 (0.007)	9.5 (8.6) 0.091 (0.082)	0.1 (0.1) 0.001 (0.001)	0.6 (0.6) 0.006 (0.005)	0.7 (0.6) 0.006 (0.006)
	4	136	2.378	0.530	2.7 (2.5) 0.020 (0.018)	1.9 (0.9) 0.007 (0.007)	12.4 (11.3) 0.091 (0.083)	0.2 (0.2) 0.001 (0.001)	0.8 (0.8) 0.006 (0.006)	0.9 (0.9) 0.007 (0.006)
	[illegible]	94	1.638	0.365	0.9 (1.7) 0.020 (0.018)	0.7 (0.6) 0.007 (0.007)	8.6 (7.8) 0.091 (0.083)	0.1 (0.1) 0.001 (0.001)	0.6 (0.5) 0.006 (0.005)	0.6 (0.6) 0.007 (0.006)
	[illegible]	115	2.006	0.447	2.3 (2.1) 0.021 (0.018)	0.8 (0.8) 0.007 (0.007)	10.5 (9.5) 0.091 (0.083)	0.2 (0.1) 0.001 (0.001)	0.7 (0.6) 0.006 (0.006)	0.8 (0.7) 0.007 (0.006)
	[illegible]	130	2.378	0.530	2.7 (2.5) 0.021 (0.018)	1.0 (0.9) 0.007 (0.007)	12.4 (11.3) 0.091 (0.083)	0.2 (0.2) 0.001 (0.001)	0.8 (0.8) 0.006 (0.006)	0.9 (0.8) 0.007 (0.006)
	[illegible]	[illegible]	2.907	0.648	3.3 (3.0) 0.016 (0.014)	1.2 (1.1) 0.006 (0.005)	15.2 (13.6) 0.071 (0.066)	0.2 (0.2) 0.001 (0.001)	1.0 (0.9) 0.005 (0.004)	1.1 (1.0) 0.005 (0.005)
	[illegible]	157	2.193	0.489	2.5 (2.3) 0.016 (0.014)	0.9 (0.8) 0.006 (0.005)	11.5 (10.4) 0.073 (0.066)	0.2 (0.2) 0.001 (0.001)	0.8 (0.7) 0.005 (0.004)	0.8 (0.7) 0.005 (0.005)
	[illegible]	197	2.748	0.612	3.1 (2.8) 0.016 (0.014)	1.1 (1.0) 0.006 (0.005)	14.4 (13.0) 0.073 (0.066)	0.2 (0.2) 0.001 (0.001)	1.0 (0.9) 0.005 (0.004)	1.0 (0.9) 0.005 (0.005)
	9	[illegible]	2.748	0.612	3.1 (2.8) 0.017 (0.016)	1.1 (1.0) 0.006 (0.006)	14.4 (13.0) 0.080 (0.073)	0.2 (0.2) 0.001 (0.001)	1.0 (0.9) 0.005 (0.005)	1.0 (0.9) 0.006 (0.005)
	10	144	2.193	0.489	2.5 (2.3) 0.017 (0.016)	0.9 (0.8) 0.006 (0.006)	11.5 (10.4) 0.080 (0.072)	0.2 (0.2) 0.001 (0.001)	0.8 (0.7) 0.005 (0.005)	0.8 (0.7) 0.006 (0.005)
	8	131	2.006	0.447	2.3 (2.1) 0.017 (0.016)	0.8 (0.8) 0.006 (0.006)	10.5 (9.5) 0.079 (0.072)	0.2 (0.1) 0.001 (0.001)	0.7 (0.6) 0.005 (0.005)	0.8 (0.7) 0.006 (0.005)
	7	132	2.006	0.447	2.3 (2.1) 0.017 (0.016)	0.8 (0.8) 0.006 (0.006)	10.5 (9.5) 0.079 (0.072)	0.2 (0.1) 0.001 (0.001)	0.7 (0.6) 0.005 (0.005)	0.8 (0.7) 0.006 (0.005)
	16	115	2.193	0.489	2.5 (2.3) 0.021 (0.020)	0.9 (0.8) 0.008 (0.007)	11.5 (10.4) 0.100 (0.090)	0.2 (0.2) 0.001 (0.001)	0.8 (0.7) 0.007 (0.006)	0.8 (0.7) 0.007 (0.006)
	15	134	2.563	0.571	2.9 (2.6) 0.022 (0.020)	1.1 (1.0) 0.008 (0.007)	13.4 (12.1) 0.100 (0.091)	0.2 (0.2) 0.002 (0.001)	0.9 (0.8) 0.007 (0.006)	1.0 (0.9) 0.007 (0.006)
4	14	[illegible]	2.378	0.530	2.7 (2.5) 0.022 (0.020)	1.0 (0.9) 0.008 (0.007)	12.4 (11.3) 0.099 (0.090)	0.2 (0.2) 0.001 (0.001)	0.8 (0.8) 0.007 (0.006)	0.9 (0.8) 0.007 (0.006)
	[illegible]	125	2.378	0.530	2.7 (2.5) 0.022 (0.020)	1.0 (0.9) 0.008 (0.007)	12.4 (11.3) 0.099 (0.090)	0.2 (0.2) 0.001 (0.001)	0.8 (0.8) 0.007 (0.006)	0.9 (0.8) 0.007 (0.006)

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$\frac{\text{Fuel Rate}}{\text{Material Process Rate}} = \frac{\text{78 Gal./Hr.}}{\text{350 Cy./Hr.}}$ * 0.22; 0.22 x total bituminous surfacing materials (CY) = total gallons fuel needed.

Table 4.1.2-41. Bituminous surfacing for DTN construction: power generator emissions from asphaltic concrete plants.

SEGMENT NO.	GROUP NO.	NO. OF CONSTRUCTION DAYS	TOTAL CUBIC YARDS OF BITUMINOUS SURFACING MATERIAL (E+05)	TOTAL GALLONS OF FUEL (E+05)	EMISSIONS TOTAL EMISSIONS TONS (TONNES) DAILY EMISSION RATE TONS/DAY (TONNES/DAY) CO	HC	NO_x	ALDEHYDES	SO_x	TSP
1	[illegible]	1[illegible]5	1.62[illegible]	0.560	2.9(2.6	[illegible]	1[illegible](11.9	[illegible](0.2	0.9(0.8	0.9(0.9
					0.027(0.025)	0.01[illegible](0.009	0.125(0.113)	0.002(0.002)	0.008(0.008)	0.009(0.008)
	4	136	[illegible].376	0.731	3.7(3.4)	1.4(1.2	17.1(15.5)	0.3(0.2)	1.1(1.0)	1.2(1.1)
					0.027(0.025)	0.01[illegible](0.009)	0.126(0.114	0.002(0.002)	0.008(0.008)	0.009(0.008)
	[illegible]	94	1.63[illegible]	0.50[illegible]	2.6(2.3	0.9(0.9	11.8(10.7	0.2(0.2)	0.8(0.7)	0.8(0.8)
					0.027(0.025	0.01[illegible](0.009	0.126(0.114	0.002(0.002)	0.008(0.008)	0.009(0.008)
	[illegible]	115	[illegible]	0.617	3.1(2.9	1.2(1.[illegible]	14.5(13.1	0.2(0.2	1.0(0.9)	1.0(0.9)
					0.027(0.025	0.010(0.009	0.126(0.114	0.002(0.002)	0.008(0.008)	0.009(0.008
	1[illegible]	136	[illegible].376	0.731	3.7(3.4	1.4(1.2	17.1(15.5	0.3(0.2)	1.1(1.0)	1.2(1.1)
					0.027(0.025)	0.01[illegible](0.009	0.126(0.114	0.002(0.002)	0.008(0.008)	0.009(0.008)
2	1	21[illegible]	[illegible].92[illegible]	[illegible].893	4.6(4.1	1.7(1.5	21.[illegible](19.[illegible]	[illegible].3(0.3	1.4(1.3)	1.5(1.4)
					0.022(0.020	0.008(0.007	0.100(0.091	0.001(0.001)	0.007(0.006)	0.007(0.006)
	[illegible]	157	[illegible].19[illegible]	[illegible].674	3.4(3.1	1.3(1.1	15.8(14.3	[illegible].2(0.2	1.1(1.0)	1.1(1.0
					0.022(0.020)	0.008(0.007	0.101(0.091	0.002(0.001)	0.007(0.006)	0.007(0.007)
	[illegible]	197	[illegible].746	0.845	4.3(3.9)	1.6(1.4	19.8(18.[illegible]	0.3(0.3)	1.3(1.2)	1.4(1.3)
					0.022(0.020)	0.008(0.007	0.101(0.091	0.002(0.001	0.007(0.006)	0.007(0.007)
3	[illegible]	179	1.74[illegible]	0.845	4.3(3.9	1.6(1.4	19.8(18.[illegible]	0.3(0.3)	1.3(1.2)	1.4(1.3)
					0.024(0.022)	0.009(0.008	0.111(0.10[illegible]	0.002(0.002)	0.007(0.007)	0.008(0.007)
	1[illegible]	144	1.193	0.674	3.4(3.1)	1.3(1.1	15.8(14.3	0.2(0.2	1.1(1.0)	1.1(1.0)
					0.024(0.022)	0.009(0.008	[illegible]	0.002(0.001)	0.007(0.007)	0.[illegible]8(0.007)
	8	132	2.008	0.617	3.1(2.9)	1.2(1.[illegible]	14.[illegible]	[illegible]	1.0(0.9)	1.0(0.9)
					0.024(0.022)	0.009(0.008	[illegible]	[illegible](0.001	0.007(0.007)	0.008(0.007)
	[illegible]	132	2.008	0.617	3.1(2.9)	[illegible]	14.[illegible]	[illegible]	1.0(0.9	1.0(0.9)
					0.024(0.022)	0.009(0.008	[illegible]	[illegible].001	0.007(0.007)	0.008(0.007
4	16	11[illegible]	[illegible].193	0.674	3.4(3.1)	1.3(1.1)	15.8(14.[illegible]	[illegible]	[illegible]	1.1(1.0)
					0.030(0.027)	0.011(0.010	[illegible]	[illegible]	0.009(0.008)	0.01[illegible](0.009)
	15	134	1.56[illegible]	[illegible].788	4.0(3.6)	1.5(1.3	1[illegible]	[illegible]	[illegible]	1.3(1.2
					0.030(0.027)	0.011(0.010	0.138(0.125	[illegible]	[illegible]	[illegible]
	14	125	[illegible].376	0.731	3.7(3.4	1.4(1.[illegible]	17.[illegible]	[illegible]	[illegible]	[illegible]
					0.030(0.027)	0.011(0.010)	[illegible]124	[illegible]	[illegible]	[illegible]
	1[illegible]	125	2.376	0.731	3.7(3.4	1.4(1.2)	17.[illegible]	[illegible]	[illegible]	[illegible]
					0.030(0.027)	0.011(0.010)	[illegible]	[illegible]	[illegible]	[illegible]

a $\frac{\text{Fuel Rate}}{\text{Material Process Rate}} = \frac{\text{[illegible] Gal Hr}}{\text{2[illegible] Cy Hr}}$ = 0.3[illegible] x total bituminous surfacing (cy) = total [illegible] fuel [illegible]

Table 4.1.2-42. Aggregate base material for DTN construction: power generator emissions from sand and gravel processing plants (Page 1 of 2).

SEGMENT NUMBER	GROUP NUMBER	NUMBER OF CONSTRUCTION DAYS	TOTAL CUBIC YARDS AGGREGATE BASE (F + 05)	TOTAL GALLONS OF FUEL[1] (E + 05)	EMISSIONS TOTAL EMISSIONS TONS (TONNES) DAILY EMISSION RATE TONS/DAY (TONNES/DAY)		
					CO	HC	NO_X
	11	216	32.90	7.332	37.4 (34.0) 0.174 (1.158)	13.8 (12.4) 0.064 (0.068)	172.0 (156.0) 0.790 (0.722)
	4	261	42.77	9.538	48.6 (44.2) 0.186 (0.170)	17.8 (16.2) 0.068 (0.062)	223.6 (202.8) 0.856 (0.778)
1	5	195	29.61	6.598	33.6 (30.6) 0.172 (0.156)	12.4 (11.2) 0.064 (0.058)	154.8 (140.4) 0.795 (0.720)
	6	216	36.19	8.066	41.2 (37.4) 0.190 (0.172)	15.2 (13.8) 0.070 (0.064)	189.2 (171.6) 0.876 (0.794)
	12	261	42.77	9.532	48.6 (44.0) 0.186 (0.168)	17.8 (16.2) 0.068 (0.062)	223.6 (202.8) 0.856 (0.776)
	1	391	52.64	11.730	59.8 (54.2) 0.154 (0.138)	22.0 (20.0) 0.056 (0.052	275.0 (249.6) 0.704 (0.638)
2	2	304	39.48	8.798	44.8 (40.6) 0.148 (0.734)	16.4 (15.0) 0.054 (0.050)	206.4 (187.2) 0.678 (0.616)
	3	239	49.35	11.004	56.2 (51.0) 0.234 (0.212)	20.6 (18.8) 0.086 (0.078)	258.0 (234.0) 1.080 (0.980)
	9	304	49.35	11.004	56.2 (51.0) 0.184 (0.168)	20.6 (18.8) 0.068 (0.060)	258.0 (234.0) 0.848 (0.770)
	10	239	49.35	11.004	56.2 (51.0) 0.184 (0.168)	20.6 (18.8) 0.068 (0.060)	258.0 (234.0) 0.848 (0.770)
3	8	216	39.48	8.798	44.8 (40.6) 0.188 (0.170)	[illegible].4 (15.0) 0.070 (0.062)	206.4 (187.2) 0/0864 (0.782)
	7	261	36.19	8.066	41.2 (37.4) 0.190 (0.172)	15.2 (13.8) 0.070 (0.064)	189.2 (171.6) 0.876 (0.794)
	16	216	39.48	8.798	44.8 (40.6) 0.208 (0.188)	16.4 (15.0) 0.076 (0.070)	206.4 (187.0) 0.956 (0.866)
	15	261	46.06	8.264	52.4 (47.4) 0.200 (0.182)	19.2 (17.4) 0.074 (0.061)	240.[illegible] (218.4) 0.922 (0.836)
4	14	239	42.77	9.532	48.6 (44.0) 0.204 (0.184)	17.8 (16.7) 0.074 (0.068)	223.6 (207.8) 0.936 (0.848)
	13	239	42.77	9.532	48.6 (44.0) 0.204 (0.184)	17.8 (16.2) 0.074 (0.068)	223.6 (202.8) 0.936 (0.848)

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Table 4.1.2-42. Aggregate base material for DTN construction: power generator emissions from sand and gravel processing plants (Page 2 of 2).

SEGMENT NUMBER	GROUP NUMBER	NUMBER OF CONSTRUCTION DAYS	TOTAL CUBIC YARDS AGGREGATE BASE (E + 05)	TOTAL GALLONS OF FUEL[1] (E + 05)	EMISSIONS TOTAL EMISSIONS TONS (TONNES) DAILY EMISSION RATE TONS DAY (TONNES DAY)		
					ALDEHYDES	SO_X	TSP
1	11	216	32.90	7.332	2.6 (2.4) 0.012 (0.010)	11.4 (10.4) 0.052 (0.048)	12.2 (11.2) 0.056 (0.052)
	4	261	42.77	9.538	3.4 (3.0) 0.012 (0.012)	14.8 (13.4) 0.058 (0.052)	16.0 (14.4) 0.062 (0.056)
	5	195	29.61	6.598	2.4 (2.2) 0.012 (0.010)	10.2 (9.4) 0.052 (0.048)	11.0 (10.0) 0.056 (0.052)
	6	216	36.19	8.066	2.8 (2.6) 0.014 (0.012)	12.6 (11.4) 0.058 (0.052)	13.6 (12.2) 0.062 (0.056)
	12	261	42.77	9.532	3.4 (3.0) 0.012 (0.012)	14.8 (13.4) 0.056 (0.052)	16.0 (14.4) 0.062 (0.046)
2	1	391	52.64	11.730	4.2 (3.8) 0.010 (0.010)	16.4 (16.6) 0.046 (0.042)	19.6 (17.8) 0.050 (0.046)
	2	304	39.48	8.798	3.0 (2.8) 0.016 (0.014)	13.8 (12.4) 0.072 (0.066)	14.8 (13.4) 0.078 (0.070)
	3	239	49.35	11.004	3.8 (3.6) 0.016 (0.014)	17.2 (15.6) 0.072 (0.066)	18.4 (16.8) 0.078 (0.070)
3	9	304	49.35	11.004	3.8 (3.6) 0.012 (0.012)	13.8 (12.4) 0.056 (0.052)	14.8 (13.4) 0.060 (0.054)
	10	239	39.48	8.798	3.0 (2.8) 0.012 (0.012)	13.8 (12.4) 0.058 (0.052)	14.8 (13.4) 0.061 (0.056)
	8	216	36.19	8.066	1.8 (2.6) 0.014 (0.012)	12.6 (11.4) 0.058 (0.050)	13.6 (12.2) 0.064 (0.056)
	7	261	36.19	8.066	2.8 (2.6) 0.010 (0.010)	12.6 (11.4) 0.048 (0.044)	13.6 (12.2) 0.052 (0.046)
4	16	216	39.48	8.798	30.0 (2.4) 0.014 (0.014)	13.8 (12.4) 0.064 (0.058)	14.8 (13.4) 0.068 (0.062)
	15	261	46.06	8.264	3.6 (3.2) 0.014 (0.012)	16.0 (14.6) 0.062 (0.056)	17.2 (15.6) 0.066 (0.060)
	14	239	42.77	9.532	3.4 (3.0) 0.014 (0.012)	14.8 (13.4) 0.062 (0.056)	16.0 (14.4) 0.066 (0.060)
	13	239	42.77	9.532	3.4 (3.0) 0.014 (0.012)	14.8 (13.4) 0.062 (0.056)	16.0 (15.0) 0.066 (0.060)

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[1] $\frac{\text{Fuel Rate}}{\text{Material Process Rate}} = \frac{\text{78 Gal. Hr.}}{\text{350 Cy. Hr.}}$ = 0.22. 0.22 x total aggregate base (cy) = total gallons fuel needed.

Table 4.1.2-43. Aggregate base material for cluster construction: power generator emissions from sand and gravel processing and stone quarrying and processing plants. (Page 1 of 2)

SEGMENT NUMBER	GROUP NUMBER	NUMBER OF CONSTRUCTION DAYS	TOTAL CUBIC YARDS OF AGGREGATE BASE (E + 05)	TOTAL GALLONS OF FUEL (E + 05)	EMISSIONS TOTAL EMISSIONS TONS (TONNES) DAILY EMISSION RATE TONS DAY (TONNES DAY)		
					CO	HC	NO_x
1	11	[illegible]	5.658	1.250	6.4 (5.8) 0.062 (0.056)	2.4 (2.2) 0.022 (0.020)	29.6 (26.5) 0.282 (0.256)
	4	136	7.380	1.624	8.4 (7.6) 0.062 (0.056)	3.0 (2.8) 0.022 (0.020)	38.6 (35.0) 0.284 (0.258)
	5	94	5.084	1.118	5.8 (5.2) 0.062 (0.056)	2.2 (2.0) 0.022 (0.020)	26.6 (24.0) 0.282 (0.256)
	6	115	6.232	1.371	7.0 (6.4) 0.062 (0.056)	2.6 (2.4) 0.022 (0.020)	32.6 (29.6) 0.284 (0.256)
	12	136	7.380	1.624	8.4 (5.6) 0.062 (0.056)	3.0 (7.8) 0.022 (0.020)	38.6 (35.0) 0.284 (0.258)
2	1	210	9.020	1.984	10.2 (9.2) 0.048 (0.044)	3.8 (3.4) 0.018 (0.016)	47.2 (42.8) 0.224 (0.204)
	2	157	6.806	1.497	7.8 (7.0) 0.050 (0.044)	2.8 (0.6) 0.018 (0.016)	35.6 (32.2) 0.226 (0.206)
	3	197	8.528	1.876	9.6 (8.8) 0.050 (0.044)	3.6 (3.2) 0.018 (0.016)	44.6 (40.4) 0.226 (0.206)
[illegible]	[illegible]	179	8.528	1.876	9.6 (8.8) 0.054 (0.050)	3.6 (3.2) 0.020 (0.018)	44.6 (40.2) 0.248 (0.226)
	10	144	6.806	1.497	7.8 (7.0) 0.054 (0.0048)	2.8 (2.6) 0.020 (0.018)	35.6 (32.2) 0.248 (0.224)
	8	132	6.232	1.371	7.0 (6.4) 0.054 (0.048)	2.6 (2.4) 0.020 (0.018)	32.6 (29.6) 0.246 (0.224)
	7	132	6.232	1.371	7.0 (6.4) 0.054 (0.048)	2.6 (2.4) 0.020 (0.018)	32.6 (29.6) 0.246 (0.224)
4	[illegible]	115	6.806	1.497	7.8 (7.0) 0.06 (0.062)	2.8 (2.6) 0.024 (0.022)	35.6 (32.2) 0.310 (0.280)
	[illegible]	134	1.054	1.750	9.0 (8.2) 0.066 (0.060)	3.4 (3.0) 0.024 (0.02)	46.8 (37.8) 0.304 (0.276)
	14	125	7.380	1.624	8.4 (7.6) 0.068 (0.030)	3.0 (2.8) 0.024 (0.022)	38.6 (25.0) 0.308 (0.280)
	[illegible]	125	7.380	1.624	8.4 (7.6) 0.068 (0.060)	3.0 (2.8) 0.024 (0.022)	38.6 (25.0) 0.308 (0.280)

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Fuel Rate / Material Process Rate = 78 Ga Hr / 350 Ty Hr = 0.22 [illegible] bituminous surfacing materials [illegible] total [illegible] fuel needed

Table 4.1.2-43. Aggregate base material for cluster construction: power generator emissions from sand and gravel processing and stone quarrying and processing plants. (Page 2 of 2)

SEGMENT NUMBER	GROUP NUMBER	NUMBER OF CONSTRUCTION DAYS	TOTAL CUBIC YARDS OF AGGREGATE BASE (E + 05)	TOTAL GALLONS OF FUEL (E + 05)	EMISSIONS TOTAL EMISSIONS TONS (TONNES) DAILY EMISSION RATE TONS DAY (TONNES DAY)		
					ALDEHYDES	SO_x	TSP
1	11	105	5.658	1.250	0.4 (0.4) 0.004 (0.004)	2.[illegible] (1.4) 0.018 (0.018)	2.2 (2.0) 0.020 (0.018)
	4	136	7.380	1.624	0.6 (0.6) 0.004 (0.004)	2.6 (2.4) 0.018 (0.018)	2.8 (2.4) 0.020 (0.018)
	5	94	5.084	1.118	0.4 (0.4) 0.004 (0.004)	1.8 (1.6) 0.018 (0.018)	1.8 (1.6) 0.020 (0.018)
	6	115	6.232	1.371	0.4 (0.4) 0.004 (0.004)	2.2 (2.0) 0.018 (0.018)	2.4 (2.2) 0.020 (0.018)
	12	136	7.380	1.624	0.6 (0.6) 0.004 (0.004)	2.6 (2.4) 0.018 (0.018)	2.8 (2.4) 0.020 (0.018)
2	1	210	9.020	1.984	0.8 (0.6) 0.004 (0.004)	3.2 (2.8) 0.014 (0.014)	3.4 (3.0) 0.016 (0.014)
	2	157	6.806	1.497	0.6 (0.4) 0.006 (0.004)	2.4 (2.2) 0.016 (0.014)	2.6 (2.4) 0.016 (0.014)
	3	197	8.528	1.876	0.6 (0.6) 0.004 (0.004)	3.0 (2.[illegible]) 0.016 (0.014)	3.2 (2.8) [illegible] ([illegible]14)
[illegible]	[illegible]	17[illegible]	8.528	1.876	0.6 (0.6) 0.006 (0.004)	3.0 (2.6) 0.016 (0.016)	3.2 (2.8) 0.018 (0.016)
	10	144	6.806	1.497	0.6 (0.4) 0.004 (0.004)	2.4 (2.2) [illegible] ([illegible]14)	2.6 (2.4) [illegible]18 (0.016)
	8	132	6.232	1.371	0.4 (0.4) 0.004 (0.004)	2.2 (2.[illegible]) [illegible] ([illegible]14)	2.4 (2.2) [illegible]18 ([illegible]16)
	7	132	6.232	1.371	0.4 (0.4) 0.004 (0.004)	2.2 (2.[illegible]) [illegible] ([illegible]14)	2.4 (2.2) [illegible]18 (0.016)
4	16	115	6.806	1.497	0.6 (0.4) 0.004 (0.004)	2.4 (2.2) 0.020 (0.018)	2.6 (2.4) 0.022 (0.020)
	15	134	1.954	1.750	0.6 (0.6) 0.004 (0.004)	2.8 (2.[illegible]) 0.020 (0.018)	[illegible] (2.6) 0.022 (0.020)
	14	125	7.380	1.624	0.6 (0.6) 0.004 (0.004)	2.6 (2.4) 0.020 (0.018)	2.8 (2.4) 0.022 (0.020)
	13	125	7.380	1.624	0.6 (0.6) 0.004 (0.004)	2.6 (2.4) 0.020 ([illegible])	2.8 (2.4) 0.022 (0.020)

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$\frac{\text{Fuel Rate}}{\text{Material Process Rate}} = \frac{78 \text{ Gal/Hr}}{350 \text{ CY/Hr}} = 0.22$ [illegible] 22 x total bituminous surfacing materials (CY) = total gallons fuel needed

Table 4.1.2-44. Concrete for Shelter Construction: generator emissions from concrete batching plants

SEGMENT NUMBER	GROUP NUMBER	NUMBER OF CONSTRUCTION DAYS	TOTAL CUBIC YARDS OF CONCRETE (E + .05)	TOTAL GALLONS OF FUEL[1] (E + .05)	EMISSIONS TOTAL EMISSIONS TONS (TONNES) DAILY EMISSION RATE TONS/DAY (TONNES/DAY)					
					CO	HC	NO_X	ALDEHYDES	SO_X	TSP
1	11	282	2.990	0.140	0.7(0.6) 0.003(0.002)	0.3(0.2) 0.001(0.001)	3.3(3.0) 0.012(0.011)	0.1(0.0) 0.000(0.000)	0.2(0.2) 0.001(0.001)	0.2(0.2) 0.001(0.001)
	4	369	3.887	0.181	0.9(0.8) 0.003(0.002)	0.3(0.3) 0.001(0.001)	4.3(3.9) 0.012(0.010)	0.1(0.1) 0.000(0.000)	0.3(0.3) 0.001(0.001)	0.3(0.3) 0.001(0.001)
	5	282	2.691	0.126	0.6(0.6) 0.002(0.002)	0.2(0.2) 0.001(0.001)	2.9(2.7) 0.010(0.009)	0.0(0.0) 0.000(0.000)	0.2(0.2) 0.001(0.001)	0.2(0.2) 0.001(0.001)
	6	282	3.289	0.153	0.8(0.7) 0.003(0.003)	0.3(0.3) 0.001(0.001)	3.6(3.3) 0.013(0.012)	0.1(0.0) 0.000(0.000)	0.2(0.2) 0.001(0.001)	0.3(0.2) 0.001(0.001)
	12	347	3.887	0.181	0.9(0.8) 0.003(0.002)	0.3(0.3) 0.001(0.001)	4.3(3.9) 0.012(0.011)	0.1(0.1) 0.000(0.000)	0.3(0.3) 0.001(0.001)	0.3(0.3) 0.001(0.001)
2	1	177	4.784	0.223	1.1(1.0) 0.002(0.002)	0.4(0.4) 0.001(0.001)	5.2(4.7) 0.011(0.010)	0.1(0.1) 0.000(0.000)	0.3(0.3) 0.001(0.001)	0.4(0.3) 0.001(0.001)
	2	391	3.588	0.167	0.9(0.8) 0.002(0.002)	0.3(0.3) 0.001(0.001)	3.9(3.6) 0.010(0.009)	0.1(0.1) 0.000(0.000)	0.3(0.2) 0.001(0.001)	0.3(0.3) 0.001(0.001)
	3	456	4.485	0.209	1.1(1.0) 0.002(0.002)	0.4(0.4) 0.001(0.001)	4.9(4.5) 0.011(0.010)	0.1(0.1) 0.000(0.000)	0.3(0.3) 0.001(0.001)	0.4(0.3) 0.001(0.001)
3	9	391	4.485	0.209	1.1(1.0) 0.003(0.002)	0.4(0.4) 0.001(0.001)	4.9(4.5) 0.013(0.011)	0.1(0.1) 0.000(0.000)	0.3(0.3) 0.001(0.001)	0.4(0.3) 0.001(0.001)
	10	304	3.588	0.167	0.0(0.8) 0.003(0.003)	0.3(0.3) 0.001(0.001)	3.9(3.6) 0.013(0.012)	0.1(0.1) 0.000(0.000)	0.3(0.2) 0.001(0.001)	0.3(0.3) 0.001(0.001)
	8	326	3.289	0.153	0.8(0.7) 0.002(0.002)	0.3(0.3) 0.001(0.001)	3.6(3.3) 0.011(0.010)	0.1(0.0) 0.000(0.000)	0.2(0.2) 0.001(0.001)	0.3(0.2) 0.001(0.001)
	[illegible]	282	3.289	0.153	0.8(0.7) 0.003(0.003)	0.3(0.3) 0.001(0.001)	3.6(3.3) 0.013(0.012)	0.1(0.0) 0.000(0.000)	0.2(0.2) 0.001(0.001)	0.3(0.2) 0.001(0.001)
4	16	304	3.588	0.167	0.9(0.8) 0.003(0.003)	0.3(0.3) 0.001(0.001)	3.9(3.6) 0.013(0.012)	0.1(0.1) 0.000(0.000)	0.3(0.2) 0.001(0.001)	0.3(0.3) 0.001(0.001)
	15	347	4.186	0.195	1.0(0.9) 0.003(0.003)	0.4(0.3) 0.001(0.001)	4.6(4.2) 0.013(0.012)	0.1(0.1) 0.000(0.000)	0.3(0.3) 0.001(0.001)	0.3(0.3) 0.001(0.001)
	14	326	3.887	0.181	0.9(0.8) 0.003(0.003)	0.3(0.3) 0.001(0.001)	4.3(3.9) 0.013(0.012)	0.1(0.1) 0.000(0.000)	0.3(0.3) 0.001(0.001)	0.3(0.3) 0.001(0.001)
	13	326	3.887	0.181	0.9(0.8) 0.003(0.003)	0.3(0.3) 0.001(0.001)	4.3(3.9) 0.013(0.012)	0.1(0.1) 0.000(0.000)	0.3(0.3) 0.001(0.001)	0.3(0.3) 0.001(0.001)

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[1] $\frac{\text{Fuel Rate}}{\text{Material Process Rate}} = \frac{7\ \text{Gal./HR.}}{150\ \text{CY/HR.}}$ 0.05; 0.05 X Total Concrete (CY) = Total Gallons Fuel Needed

Table 4.1.2-45. Concrete for shelter construction - power generator emissions - sand and gravel processing and stone quarrying and processing plants.

SEGMENT NUMBER	GROUP NUMBER	NUMBER OF CONSTRUCTION DAYS	TOTAL CUBIC YARDS OF CONCRETE ([illegible])	TOTAL [illegible]	EMISSIONS TOTAL EMISSIONS TONS (TONNES) DAILY EMISSION RATE TONS/DAY (TONNES/DAY)					
					CO	HC	NO_x	ALDEHYDES	SO_x	TSP
	11	282	1.93[illegible]	[illegible]	3.4 (3.1) 0.012 (0.011)	1.2 (1.1) 0.004 (0.004)	15.[illegible] (14.[illegible]) 0.055 [illegible]	[illegible]	[illegible] [illegible]	[illegible] 0.004 (0.004)
	4	364	3.887	0.866	4.4 (4.0) 0.012 (0.011)	1.[illegible] (1.5) 0.004 (0.004)	[illegible] (18.4) 0.055 [illegible]	[illegible]	1.4 [illegible] [illegible]	[illegible] [illegible]
[illegible]	[illegible]	28[illegible]	[illegible]	[illegible]	3.1 (2.8) 0.011 (0.010)	[illegible] 0.004 (0.004)	14.[illegible] [illegible] 0.050 (0.045)	[illegible] [illegible]	[illegible] [illegible]	[illegible] 0.004 [illegible]
	[illegible]	282	3.284	0.733	3.7 (3.4) 0.013 (0.012)	1.4 (1.2) 0.005 (0.004)	17.[illegible] (15.6) 0.061 [illegible]	[illegible] [illegible]	[illegible] 0.004 [illegible]	[illegible] [illegible]
	11	347	3.887	0.866	4.4 (4.0) 0.013 (0.012)	1.6 (1.5) 0.005 (0.004)	20.3 (18.4) 0.059 [illegible]	[illegible] [illegible]	1.4 [illegible] [illegible]	[illegible] [illegible]
	[illegible]	47[illegible]	4.784	1.066	5.4 (4.9) 0.011 (0.010)	(2.0) (1.8) 0.004 (0.004)	25.[illegible] (22.7) 0.052 (0.048)	0.4 [illegible] 0.001 0.001	1.7 1.5 [illegible]	[illegible] [illegible]
[illegible]	[illegible]	3[illegible]	3.588	0.80[illegible]	4.1 (3.7) 0.010 (0.009)	1.5 (1.4) 0.004 (0.003)	18.5 (17.[illegible]) 0.046 (0.043)	[illegible] 0.001 (0.001)	[illegible] [illegible]	[illegible] [illegible]
	[illegible]	45[illegible]	4.487	1.00[illegible]	5.1 (4.6) 0.011 (0.010)	1.9 (1.7) 0.004 (0.004)	23.4 (21.3) 0.051 (0.047)	0.4 [illegible] 0.001 [illegible]	1.6 1.4 [illegible]	[illegible] 1.5 0.004 [illegible]
	[illegible]	33[illegible]	4.485	1.00[illegible]	5.1 (4.6) 0.015 (0.012)	(1.9 (1.7) 0.005 (0.004)	23.4 (21.3) 0.060 (0.054)	0.4 (0.3) [illegible]	1.6 1.4 0.004 [illegible]	1.7 1.5 0.004 [illegible]
[illegible]	[illegible]	3[illegible]4	3.556	0.80[illegible]	4.1 (3.7) 0.013 (0.012)	1.5 (1.4) 0.005 (0.004)	18.5 (17.[illegible]) 0.061 (0.056)	[illegible] [illegible]	[illegible] 0.004 0.004	[illegible] 0.004 [illegible]
	[illegible]	[illegible]	[illegible]	0.733	3.7 (3.4) 0.011 (0.010)	1.4 (1.2) 0.004 (0.004)	17.[illegible] (15.[illegible]) 0.05[illegible] (0.046)	[illegible] [illegible]	[illegible] [illegible]	[illegible] [illegible]
	[illegible]	26[illegible]	[illegible]	0.733	3.7 (3.4) 0.013 (0.012)	1.4 (1.2) 0.005 (0.004)	17.[illegible] (15.[illegible]) [illegible]	[illegible] [illegible]	[illegible] [illegible]	[illegible] [illegible]
4	1[illegible]	3[illegible]4	3.566	0.80[illegible]	4.1 (3.7) 0.013 (0.012)	1.5 (1.4) 0.005 (0.004)	18.6 (17.[illegible]) [illegible]	[illegible] [illegible]	[illegible] [illegible]	[illegible] [illegible]
	1[illegible]	347	4.18[illegible]	0.933	4.6 (4.3) 0.014 (0.012)	1.7 (1.6) 0.005 (0.005)	[illegible] (19.8) [illegible]	0.2 [illegible] [illegible]	[illegible] [illegible]	[illegible] 1.4 [illegible]
	[illegible]4	326	3.887	0.866	4.4 (4.0) 0.014 (0.012)	1.6 (1.5) [illegible]	[illegible] 18.4 [illegible]	[illegible] [illegible]	1.4 [illegible] [illegible]	[illegible] [illegible]
	[illegible]	326	3.887	0.866	4.4 (4.0) 0.014 (0.012)	1.6 (1.5) [illegible]	[illegible] 18.4 [illegible]	[illegible]	1.4 [illegible] [illegible]	1.5 [illegible] [illegible]

Fuel Rate / Material Process Rate = 74 Gal/Hr / [illegible] Cy Hr = [illegible] x total concrete (cy) = total gallons of fuel

Table 4.1.2-46. Emission factors for diesel-powered industrial equipment

Pollutant	Emission Factor (lb/10^3 Gallons Fuel)
Carbon monoxide	102.
Exhaust hydrocarbons	37.5
Nitrogen oxides	469.
Aldehydes	7.04
Sulfur oxides	31.2
Particulates	3.5

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generator daily emission rates are average values. NO_x emission rates are the largest, with annual rates approaching or exceeding 100 tons/year.

OPERATING BASE: VEHICULAR EMISSIONS ON THE HIGHWAY FROM THE OPERATING BASE TO THE SUPPORT COMMUNITY (4.1.3)

Pollutant level increases in the area surrounding the operating base will occur due to increased flow of vehicle traffic throughout the region. The greatest concentration increases will be observed along the stretch of major highway which serves as the connecting link between the base and the support community. Traffic on this section of the highway will be a combination of the normal daily transient traffic flow and the base-related traffic. The crosssection of vehicle types traveling on the highway link is assumed to be representative of the national average vehicle mix as given in Table 4.1.3-1. Emission factors for these types of vehicles are presented in Table 4.1.3-2. These emission factors are extremely conservative, particularly considering the assumption of 1975.

For modeling purposes, the emissions from a "composite" vehicle determined by the national average vehicle mix (Table 4.1.3-1) were calculated by multiplying the fraction of cars, light duty trucks, heavy duty trucks (gas), and heavy duty trucks (diesel) by the appropriate emission factor (Table 4.1.3-2).

$$CO;\ (0.8 \times 45) + (0.12 \times 76.3) + (0.05 \times 288.1) + (0.03 \times 27) = 60.4 \text{ g/mi}$$

$$HC;\ (0.8 \times 5.06) + (0.12 \times 8.35) + (0.05 \times 30.0) + (0.03 \times 4.5) = 6.69 \text{ g/mi}$$

$$NO_x;\ (0.8 \times 3.2) + (0.12 \times 3.6) + (0.05 \times 10.5) + (0.03 \times 20.1) = 4.12 \text{ g/mi}$$

$$SO_x;\ (0.8 \times 0.13) + (0.12 \times 0.18) + (0.05 \times 0.36) + (0.03 \times 2.8) = 0.23 \text{ g/mi}$$

$$TSP;\ (0.8 \times 0.54) + (0.12 \times 0.54) + 0.05 \times (0.91 + 0.2(\tfrac{6}{4})) + 0.03 \times (1.3 + 0.2(\tfrac{18}{4})) = 0.62 \text{ g/mi}$$

Table 4.1.3-3 is a summary of pollutant emission rates reported on the basis of vehicle volume per hour. These rates were used along with various meteorological assumptions as input parameters for HIWAY modeling. Results of the modeling are reported in Section 5 of this report.

4.2 METEOROLOGICAL DATA

MODEL INPUT REQUIREMENTS (4.2.1)

In order to numerically simulate the atmospheric transport of M-X-related emissions, it was necessary to provide meteorological data pertinent to the location of interest and to the dispersion model used. The IMPACT model requires, as a minimum level of input, wind speeds and directions at one location in the model grid for each hour of the simulation. Additionally, an atmospheric stability-class vertical profile is necessary for at least one location in the grid consisting of a Pasquill stability-class assigned to each model layer in the vertical. This data determines the amount of vertical dispersion that occurs as well as the vertical extent of mixing.

Table 4.1.3-1. National average vehicle type mix.

Vehicle Type	Percent
Motorcycles	0
Cars	80
Light-duty trucks	12
Heavy-duty trucks or buses (gas)	5
Heavy-duty trucks or buses (diesel)	3

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Table 4.1.3-2. Emission factors used for vehicles associated with the operating base.

VEHICLE TYPE	CO (g/mi)	HC[a] (g/mi)	NO_x (g/mi)	SO_x (g/mi)	TSP[b] (g/mi)
Automobile	45.0	3.3 1.76 5.06	3.2	0.13	0.54
Light-duty truck	76.3	6.2 2.15 8.35	3.6	0.18	0.54
Heavy-duty (gas)	288.1	28.0 2.0 30.0	10.5	0.36	$0.91 + 0.2(\frac{W}{4})$
Heavy-duty (diesel)	27.0	4.5 N/A 4.5	20.1	2.8	$1.3 + 0.2(\frac{W}{4})$

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[a]Total hydrocarbon emission factor is sum of exhaust emission factor and crankcase/evaporative emission factor.

[b]Includes both exhaust and tire wear. An adjustment is made for trucks with more than 4 wheels. W equals number of wheels.

1982 calendar year using 1975 vehicles. Standard Test conditions.

Source: "Mobile Source Emission Factors," EPA. March, 1978.

Table 4.1.3-3. Emission rates based on vehicle volume per hour (g/sec-m),

VOLUME	CO	HC	NO_x	SO_x	TSP
1. 100	0.001	0.0001	$0.7x10^{-4}$	$4.0x10^{-6}$	$1.1x10^{-5}$
2. 500	0.005	0.0006	$0.3x10^{-3}$	$2.0x10^{-5}$	$5.4x10^{-5}$
3. 1,000	0.010	0.0012	$0.7x10^{-3}$	$4.0x10^{-5}$	$1.1x10^{-4}$
4. 1,500	0.016	0.0019	$1.1x10^{-3}$	$6.0x10^{-5}$	$1.6x10^{-4}$
5. 2,000	0.021	0.0025	$1.4x10^{-3}$	$7.9x10^{-5}$	$2.1x10^{-4}$
6. 2,500	0.026	0.0031	$1.8x10^{-3}$	$9.9x10^{-5}$	$2.7x10^{-4}$
7. 5,000	0.052	0.0062	$3.6x10^{-3}$	$2.0x10^{-4}$	$5.4x10^{-4}$
8. 7,500	.078	0.0093	$5.4x10^{-3}$	$2.99x10^{-4}$	$8.1x10^{-4}$

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The preferred form of input to IMPACT consists of wind profiles extending to the highest layer specified in the model simulation. However, winds specified at one level are sufficient to drive the model calculations as the model will extrapolate upper level winds from surface winds by considering the stability profile. It is extremely beneficial in areas of complex terrain to have input wind information at more than one location. If a single location for input winds is used, then all of the grid cells in the model will contain winds characteristics of that one location, although modified somewhat by the terrain. To capture thermal effects on local flows, mesoscale circulation patterns, and topographic influences, such as channeling of the wind, it is necessary to have input winds at several locations in the region of interest.

The meteorological input requirements for the HIWAY and PAL models are different than that required for IMPACT. Both HIWAY and PAL models are steady-state Gaussian models so the wind data are only needed at one location and are considered to be constant both vertically and horizontally throughout the area for which concentrations are being calculated. In addition to wind speed and direction data for each hour, atmospheric stability-class and mixing height data are needed as input. The stability-class is used in the calculation of the vertical dispersion coefficient while the mixing height represents an upper limit to the extent to which pollutants can be vertically mixed. In these models, the stability-class is assumed to be constant from the surface to the mixing height. Generally, the ground surface stability-class is used as input to the model.

METEOROLOGICAL SCENARIOS FOR IMPACT (4.2.2)

Site-specific meteorological data were not available for the various operating bases (OB) and dedicated deployment area (DDA) valleys to which IMPACT was applied. As an alternative to actual data, various meteorological scenarios were used as input to the model calculations. These meteorological scenarios represented wind and stability regimes typical of those which occur in the individual locations. Meteorological conditions were chosen that would tend to result in high concentrations, although not necessarily in worst-case concentrations.

Climatological wind data from the Nevada Test Site and Nuclear Rocket Development Station were used for guidance in the selection of the Dry Lake-Delamar Valley meteorology. The test site data represented wind regimes typical of a basin and range system. These data contained the monthly and hourly climatology of wind speeds and direction both on a valley floor and on nearby mountaintops and slopes.

For Dry Lake-Delamar Valley five locations for input winds were selected. Four of these locations were on elevated terrain and one on the valley floor. The winds selected for these five points represent a situation similar to a low wind-speed day in April at the Nevada Test Site. Five locations for input winds were chosen in an attempt to account for the early morning upslope wind that occurs as a result of heating on the western slopes. The initial winds at 8:00 a.m. are extremely light and blowing slightly up the mountains on the west site of the valley to represent the thermal effects present early in the morning. By mid-morning, the winds have shifted to an up-valley flow from the south which peaks during the mid-afternoon. Winds at upper elevations are of a somewhat greater wind speed as was indicated to be the usual situation in the Nevada Test Site data.

The up-valley wind case is potentially the worst condition for high pollutant concentrations because it maximizes the cumulative effects of all of the upwind emission sources on downwind receptors due to the orientation of the M-X system along the valley floor. Atmospheric stability is assumed to change from stable to slightly unstable at the surface after solar heating of the valley floor occurs in the morning. The stability returns to neutral in the afternoon as wind speeds increase and the atmosphere is well mixed. Above 500 m, the atmosphere is assumed to remain neutral throughout the simulation (see Table 4.2.2-1).

The meteorological conditions input for Steptoe Valley simulation are similar to those for Dry Lake-Delamar with the exception of the wind direction (Table 4.2.2-2). The prevailing wind direction in Steptoe Valley is from the south which would transport the operating base emissions towards the town of Ely. The simulations at Beryl, Coyote Spring, and Delta represented morning conditions, with light winds blowing from the southwest (Tables 4.2.2-3, 4.2.2-4, and 4.2.2-5). The model run for Duckwater consisted of a flow reversal case. This consists of light winds from the north at 8 a.m. and 9 a.m., changing to light southerly winds at 10 a.m. (Table 4.2.2-6). These conditions occur frequently in a mountain-valley system and can produce high pollutant concentrations by transporting previously emitted pollutants back over the source area.

The meteorological conditions assumed for the Texas/New Mexico model runs (Clovis, Hereford, Dalhart) were basically similar to each other (Tables 4.2.2-7 and 4.2.2-8). The prevailing winds were assumed to be from the west-southwest, which is typical of this region. Early morning conditions were assumed to be a stable atmosphere with light wind speeds of 4 to 5 mi per hour. By late morning or early afternoon, winds had increased to 12 to 15 mi per hour and the atmospheric conditions were neutral.

METEOROLOGICAL INPUT TO PAL AND HIWAY (4.2.3)

The EPA Gaussian models PAL and HIWAY were used to calculate localized maximum concentrations during construction activities and at the potential operating base (OB) locations. PAL was used to estimate particulate concentrations due to shelter construction emissions. Meteorological input consisted of worst-case mixing height, wind speed, and stability-class values observed for a one-day period and a five-day period at Ely, Nevada. Wind direction was assumed to be that which produced maximum downwind concentrations.

PAL was also used to model the air pollution concentrations of OB construction. Theoretical mixing height, wind speed, and stability-classes producing poor dilution were used. The conditions used were a wind speed of 5 meters per second, a 500 meter mixing height, and a stable atmosphere which are similar to the worst five-day conditions reported for Amarillo, Texas. Because of limitations of the PAL model as discussed earlier in Section 3.4, and in the emissions data for the OB construction, it was not considered necessary to use more refined meteorological data. The PAL results are presented only to give a rough approximation of particulate problems to be expected near construction activity.

The HIWAY model was used to model very localized concentrations associated with peak hour traffic during OB operation. Hypothetical worst case meteorological conditions of a one meter per second wind parallel to the roadway, 25 meter mixing

Table 4.2.2-1. IMPACT modeled meteorological conditions for Delamar/Dry Lake Valley (Valleys 181 and 182).

Station	Hour	Grid Coord.[1] I	Grid Coord.[1] J	Wind Speed (M/Sec)	Wind Direction (Deg)	Pasquill Stability Class
1	0600	5	21	0.4	315	E-D
2	(Before start of	9	21	0.4	80	(Lower level
3	construction)	6	13	1.3	0	inversion)
4		2	6	0.9	270	
5		7	5	0.9	120	
1	0800	5	21	1.3	90	E-D
2	(Start of	9	21	0.9	100	(Lower level
3	construction)	6	13	0.9	0	inversion)
4		2	6	1.3	90	
5		7	5	1.3	130	
1	1000	5	21	3.1	170	D
2		9	21	2.7	220	(Neutral to
3		6	13	1.8	180	mixing height)
4		2	6	3.1	180	
5		7	5	2.7	230	
1	1300	5	21	4.5	210	C-D
2		9	21	5.4	190	(Class C for
3		6	13	3.6	200	ground layer)
4		2	6	4.9	200	
5		7	5	5.8	190	
1	1700	5	21	4.5	240	D
2	(After	9	21	5.4	230	(Neutral to
3	construction)	6	13	4.5	180	mixing height)
4		2	6	4.9	170	
5		7	5	4.9	210	

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[1] See Figure 5.1.1-1 for grid layout.

Table 4.2.2-2. IMPACT model meteorological conditions for Ely, Nevada, OB site.

STATION	GRID COORD.[1] I	GRID COORD.[1] J	HOUR	WIND SPEED (M/SEC)	WIND DIRECTION (DEG)	PASQUILL STABILITY CLASS
1	7	21	6:00 a.m.	1.3	180	E
2	9	12	6:00 a.m.	0.9	100	E
3	11	3	6:00 a.m.	1.3	130	E
1	7	21	7:00 a.m.	1.8	190	E
2	9	12	7:00 a.m.	2.2	130	E
3	11	3	7:00 a.m.	1.8	190	E
1	7	21	8:00 a.m.	1.8	170	E
2	9	12	8:00 a.m.	2.7	180	E
3	11	3	8:00 a.m.	2.7	200	E
1	7	21	9:00 a.m.	2.2	150	D
2	9	12	9:00 a.m.	2.7	200	D
3	11	3	9:00 a.m.	3.6	210	D
1	7	21	10:00 a.m.	3.1	180	D
2	9	12	10:00 a.m.	3.6	170	D
3	11	3	10:00 a.m.	2.7	190	D
1	7	21	11:00 a.m.	3.6	170	D
2	9	12	11:00 a.m.	3.6	190	D
3	11	3	11:00 a.m.	3.6	180	D
1	7	21	12:00 p.m.	3.6	160	D
2	9	12	12:00 p.m.	3.6	170	D
3	11	3	12:00 p.m.	4.5	190	D
1	7	21	1:00 p.m.	4.5	170	D
2	9	12	1:00 p.m.	4.9	150	D
3	11	3	1:00 p.m.	4.5	200	D

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[1]See Figure 5.1.1-7 or 5.1.1-8 for grid layout.

Table 4.2.2-3. IMPACT model meteorological conditions for the Beryl, Utah, region.

Station	Time	Grid Location[1] I	Grid Location[1] J	Wind Speed (meters/sec)	Wind Direction (Degrees from North)	Stability Class
1	8:00 a.m.	2	8	1.3	230	E
2		4	2	1.8	290	E
3		18	6	1.3	270	E
1	9:00 a.m.	2	8	1.8	240	E
2		4	2	0.9	270	E
3		18	6	0.9	250	E
1	10:00 a.m.	2	8	4.9	230	D
2		4	2	4.9	190	D
3		18	6	4.0	270	D
1	11:00 a.m.	2	8	5.8	260	D
2		4	2	5.4	210	D
3		18	6	3.6	280	D

T2110/9-22-81/F

[1]See Figure 5.1.1-9 or 5.1.1-10 for grid layout.

Table 4.2.2-4. IMPACT model meteorological conditions for Coyote Spring, Nevada OB site.

Station	Time	Grid Coordinates I	Grid Coordinates J	Wind Speed (m/sec)	Wind Direction (Deg)	Pasquill Stability Class
1	0800	4	6	1.3	180	E
2	0800	13	3	0.9	120	
1	0900	4	6	1.3	160	E
2	0900	13	3	1.3	110	
1	1000	4	6	4.0	170	D-E
2	1000	13	3	3.6	160	
1	1100	4	6	4.5	180	D
2	1100	13	3	4.0	170	

T2301/8-27-81

Table 4.2.2-5. IMPACT model meteorological conditions for Delta area (Valley 46).

Station	Hour	Grid Coordinates[1] I	Grid Coordinates[1] J	Wind Speed (M/Sec)	Wind Direction (DEG)	Pasquill Stability Class
1		4	11	2.2	315	E-D
2	0800	7	2	2.7	225	(Lower level inversion)
3		13	8	2.2	270	
1		4	11	2.7	300	E-D
2	0900	7	2	2.7	235	(Lower level inversion)
3		13	8	2.7	270	
1		4	11	5.4	290	D-E-D
2	1000	7	2	4.9	250	(Inversion breaking up)
3		13	8	4.5	270	
1		4	11	5.8	290	D
2	1100	7	2	5.4	260	(Neutral to mixing height)
3		13	8	5.4	270	

T2195/10-2-81

[1] See Figure 5.1.1-3 for grid layout.

Table 4.2.2-6. IMPACT model meteorological conditions for Duckwater area (Valley 173B).

Station	Hour	Grid Coordinates[1] I	Grid Coordinates[1] J	Wind Speed (M/Sec)	Wind Direction (Deg)	Pasquill Stability Class
1	0800	3	4	1.3	360	E-D
2		3	13	1.8	20	(Lower level inversion)
1	0900	3	4	1.8	350	E-D (Lower level
2		3	13	1.3	360	inversion)
1	1000	3	4	4.5	170	D-E-D
2		3	13	5.4	160	(Inversion breaking up)
1	1100	3	4	5.4	180	D
2		3	13	5.8	170	(Neutral to mixing height)

T2196/9-22-81/F

[1]See Figure 5.1.1-2 for grid layout.

Table 4.2.2-7. IMPACT model meteorological conditions for Dalhart, Texas, and Clovis, New Mexico areas.

Hour	Station	Grid Coordinate[1] I	Grid Coordinate[1] J	Wind Speed (m/sec)	Wind Direction (degree)	Pasquill Stability Class
0800	1	5	5	1.8	240	E
0900	1	5	5	2.7	255	E
1000	1	5	5	5.8	260	D-E
1100	1	5	5	6.3	250	D

T2285/8-26-81

[1] See Figure 5.1.1-4 for grid layout.

AD-A149 903 DEPLOYMENT AREA SELECTION AND LAND 3/4
WITHDRAWAL/ACQUISITION M-X/MPS (M-X/MU.. (U) HENNINGSON
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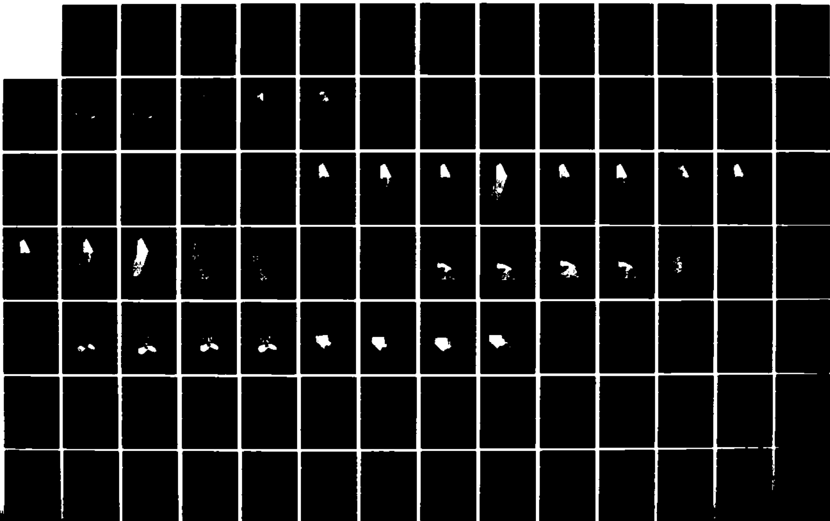
UNCLASSIFIED M-X-ETR-13 F/G 16/1 NL



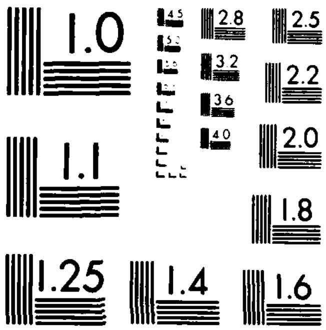

1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0

Table 4.2.2-8. IMPACT model meteorological conditions for Hereford, Texas area.

Hour	Station	Grid Coordinate[1]		Wind Speed	Wind Direction	Pasquill Stability Class
		I	J	(m/sec)	(degree)	
0800	1	5	5	1.8	240	E
0900	1	5	5	2.2	255	E
1000	1	5	5	5.8	260	D-E
1100	1	5	5	6.3	250	D

T2284/9-21-81

[1] See Figure 5.1.1-6 for grid layout.

height, and a very stable atmosphere were assumed and used to predict worst-case concentrations. These conditions are extreme worst-case, and would probably not ever actually occur.

5.0 MODELING RESULTS

As mentioned in Section 4.1.1, the air quality modeling was performed based upon preliminary system designs. Further, meteorological data for the area are very limited. In spite of data limitations, it was felt that the magnitude of the air quality impacts could be gauged through a general application of the HIWAY, PAL, and ISC models, developed for EPA, supplemented by simulations provided by the IMPACT complex terrain computer model. The results presented here should be viewed as preliminary, and will be refined as more specific data become available if the new data indicate that a significant change in results will occur.

5.1 IMPACT MODELING RESULTS

EMISSION GRIDS (5.1.1)

The area to be modeled is divided by a grid consisting of square grid cells of a predetermined size. Size of the grid squares is determined by the user according to the degree of geographic resolution warranted by the particular conditions modeled. The IMPACT model requires an emission value for each grid cell. The IMPACT model was applied to predict regional scale impacts. Grid cells 4 km square were deemed appropriate for modeling construction activity in the deployment area, whereas, grid cells 4,000 ft by 4,000 ft were used in modeling the concentrations of gaseous pollutants around the OB sites during system operation.

The areas selected for construction modeling were Dry Lake-Delamar valleys and Duckwater Valley in Nevada; Delta, Utah; Dalhart, Texas; Clovis, Texas; and Hereford, New Mexico (Figures 5.1.1-1 through 5.1.1-6).

The emission grids used for the OB sites of Ely, Nevada; Beryl, Utah; Coyote Springs, Nevada; and Clovis, Texas are shown in Figure 5.1.1-7 through 5.1.1-14. The emission values assigned to the grid cell are given in grams per second and placed directly on these figures. A CO and NO_x emission grid is given for each OB site.

DIGITIZED TERRAIN (5.1.2)

The IMPACT model is capable of handling wind flow around features of complex terrain and simulating a wide variety of meteorologic conditions characteristic of the landscape in question. To implement this capacity, it was necessary to input an averaged value of terrain height for each of the grid cells used to define the modeling area. The grid cells correspond to the emission grids shown in Figures 5.1.1-1 through 5.1.1-14 in the previous section. Average terrain height values were obtained for each of these cells by overlaying the grid on a topographic map of the area and digitizing contour lines. An example topographic map of the modeled areas is shown in Figures 5.1.2-1.

PREDICTED POLLUTANT CONCENTRATIONS - NEVADA/UTAH (5.1.3)

Construction and operating activities related to the M-X will result in the emission of several atmospheric pollutants. These include total suspended particulate matter (TSP), nitrogen oxides (NO_x), sulfur oxides (SO_x), carbon

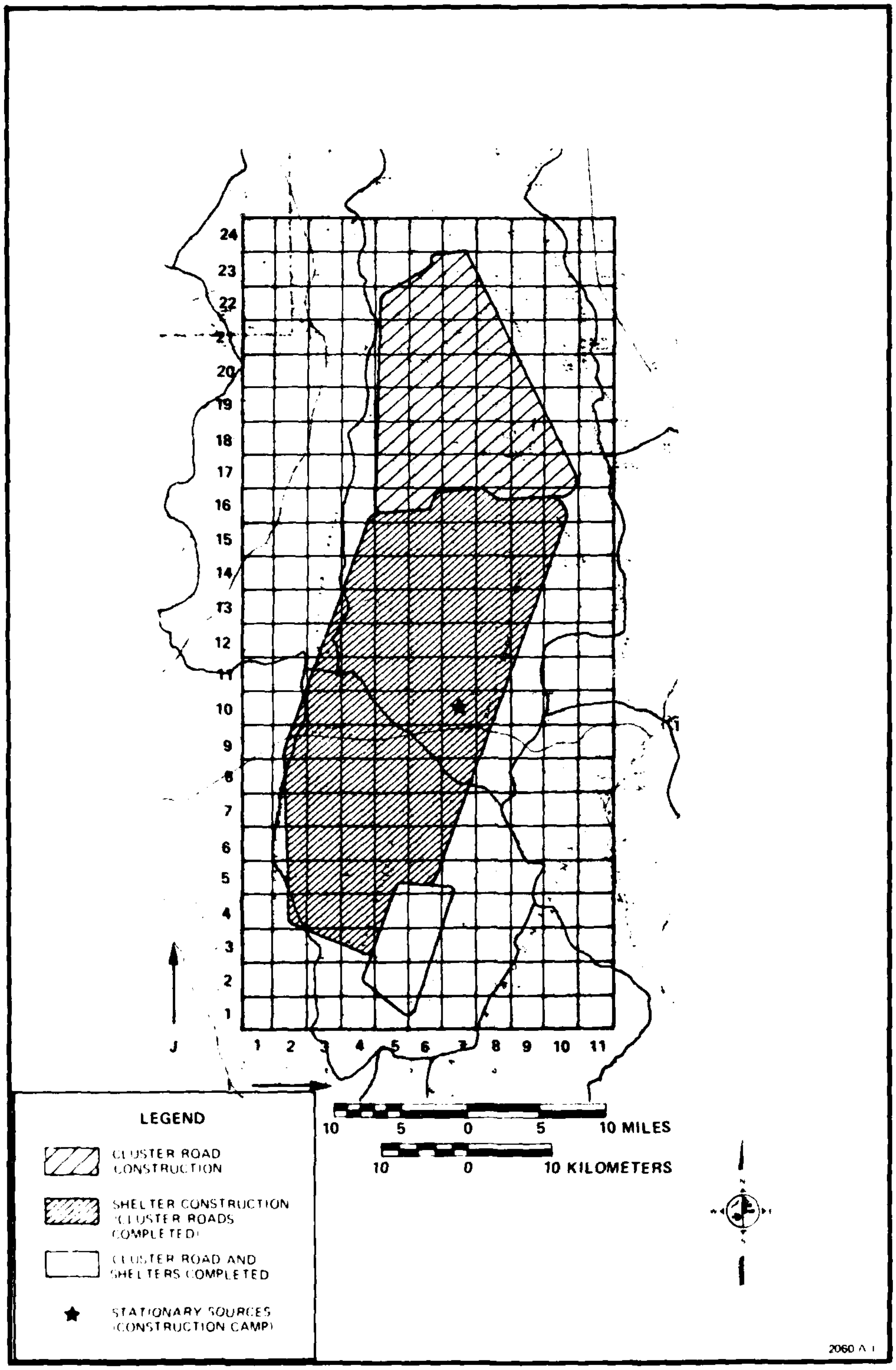


Figure 5.1.1-1. Emission grid for the Dry Lake/Delamar construction group.

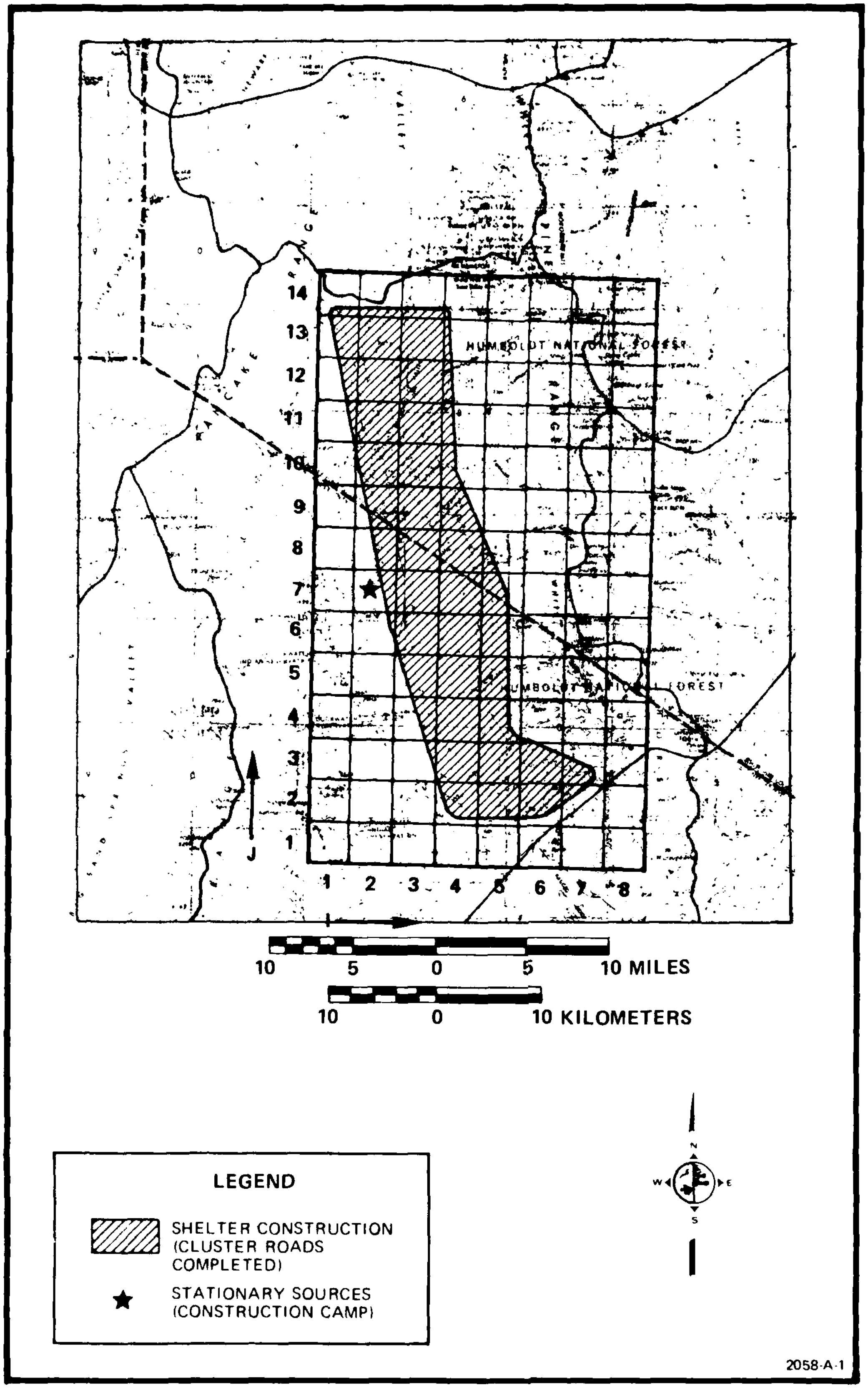


Figure 5.1.1-2. Emission grid for the Duckwater, Nevada construction group.

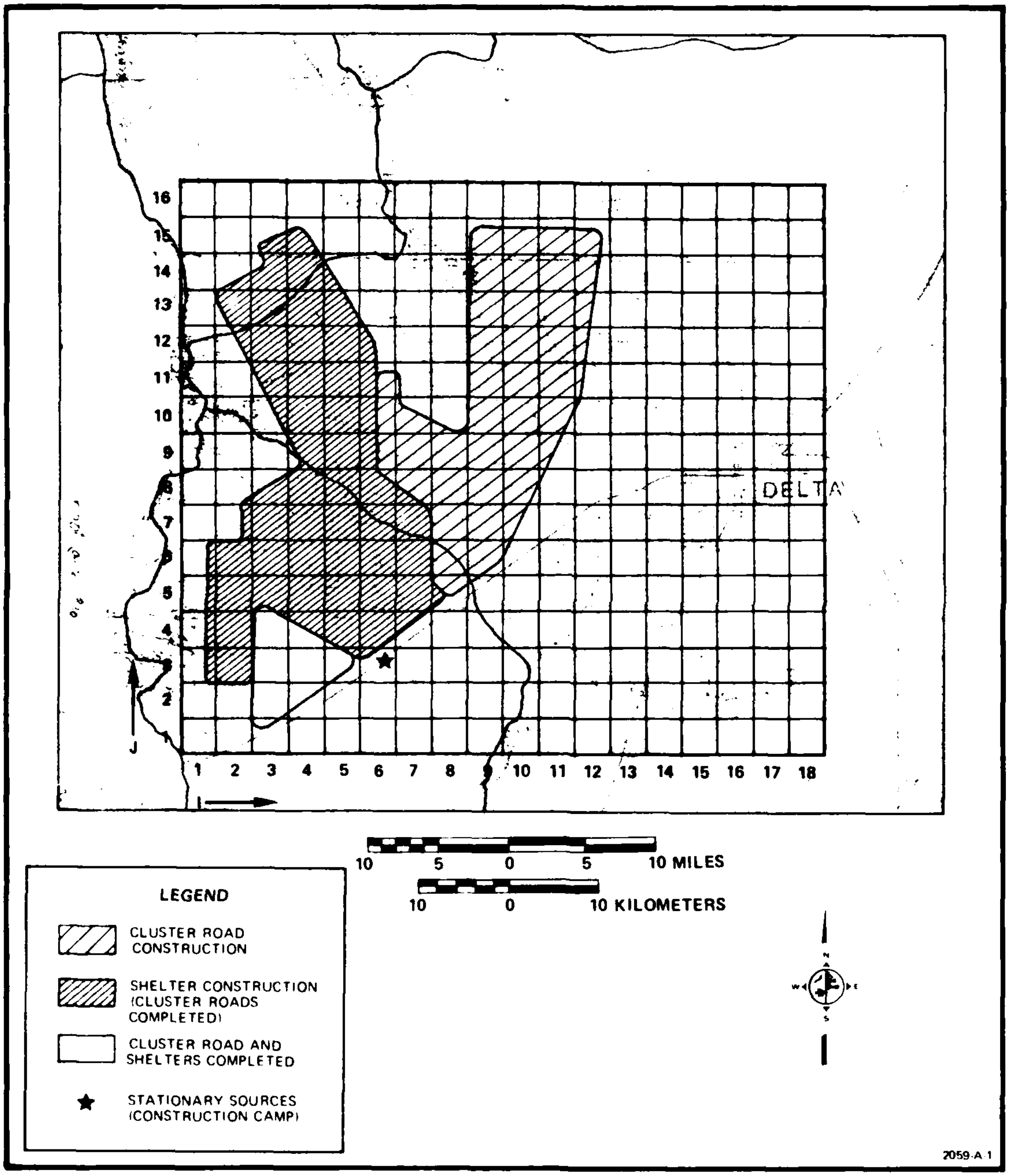


Figure 5.1.1-3. Emission grid for the Delta, Utah construction group.

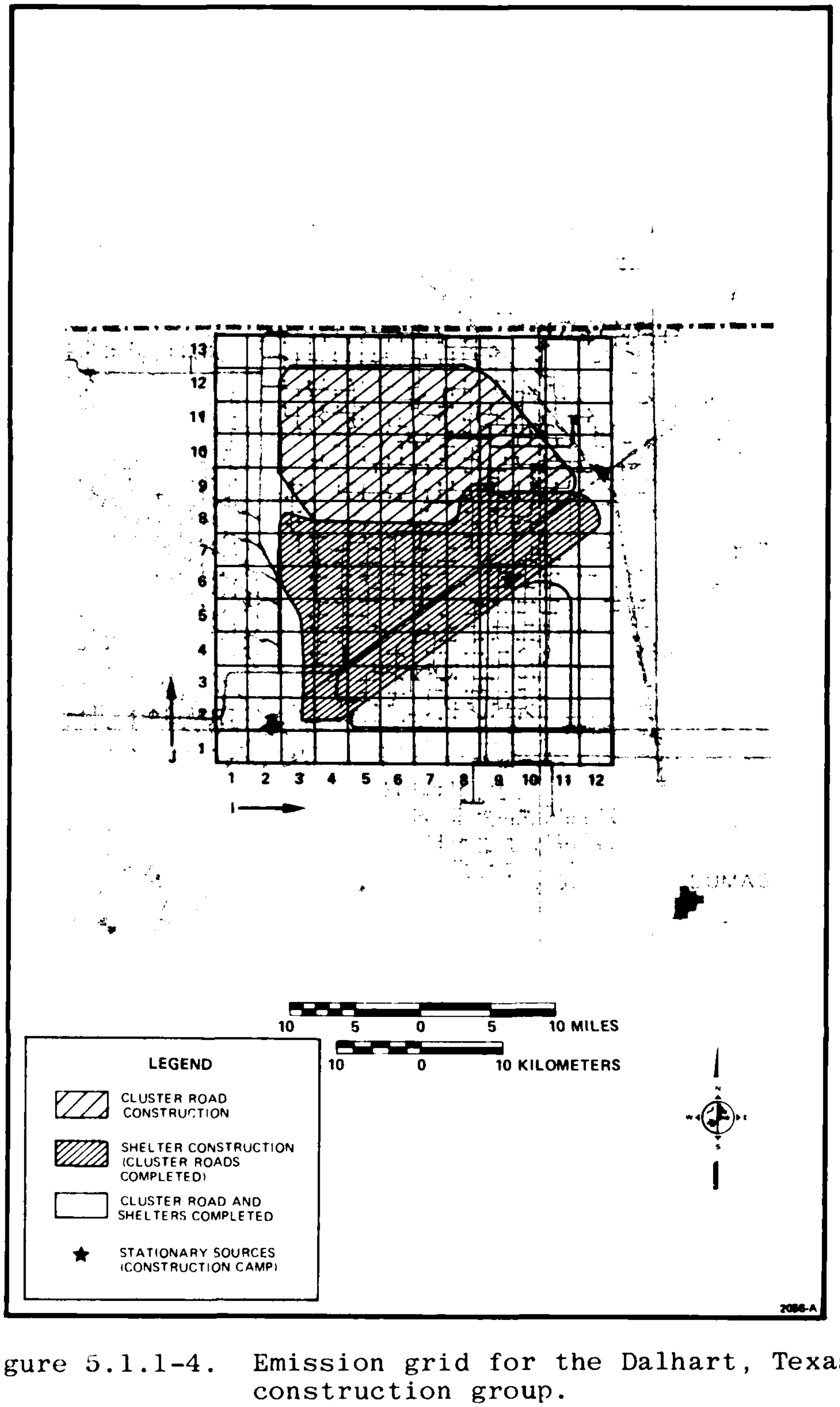


Figure 5.1.1-4. Emission grid for the Dalhart, Texas construction group.

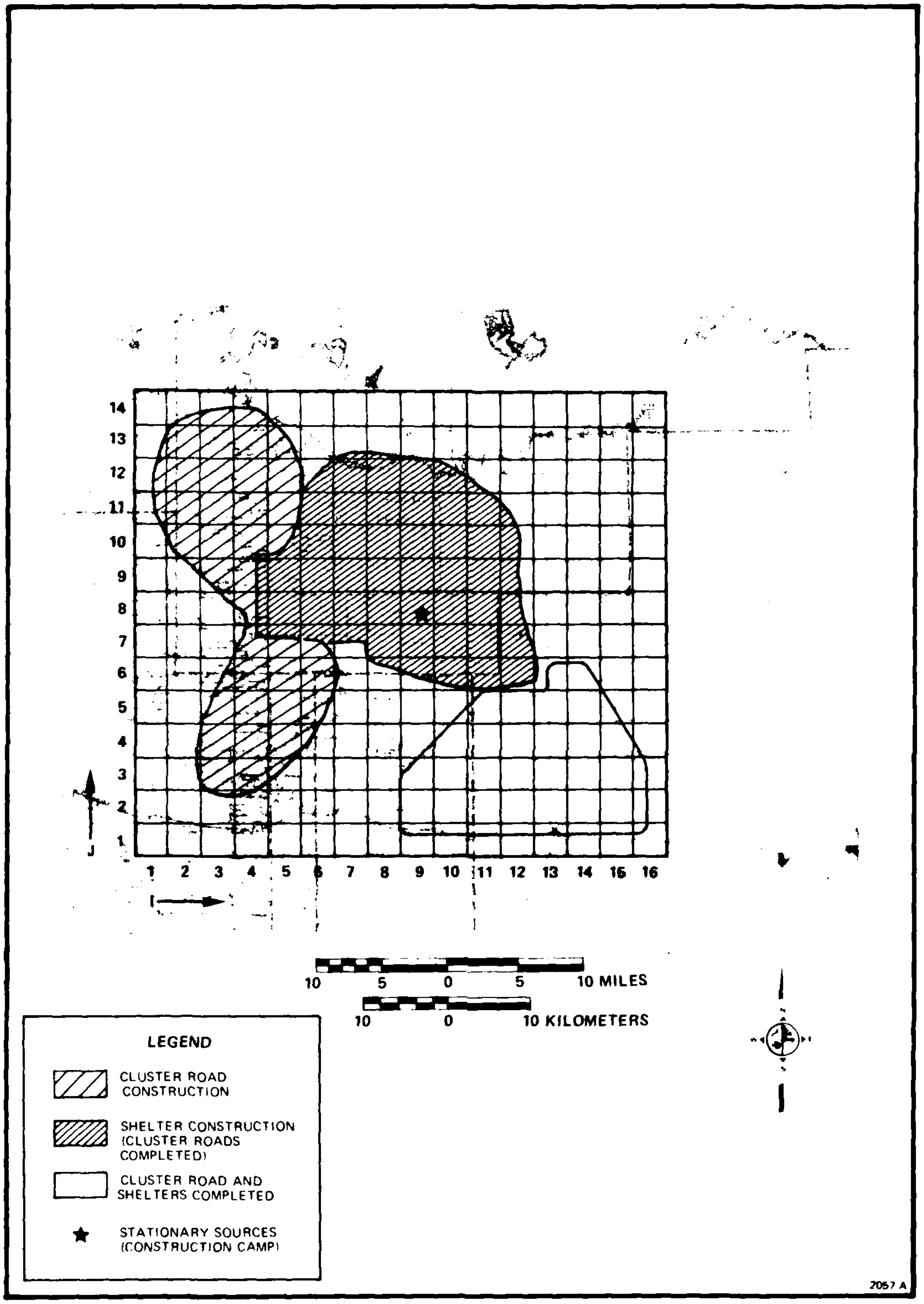


Figure 5.1.1-5. Emission grid for the Clovis, New Mexico construction group.

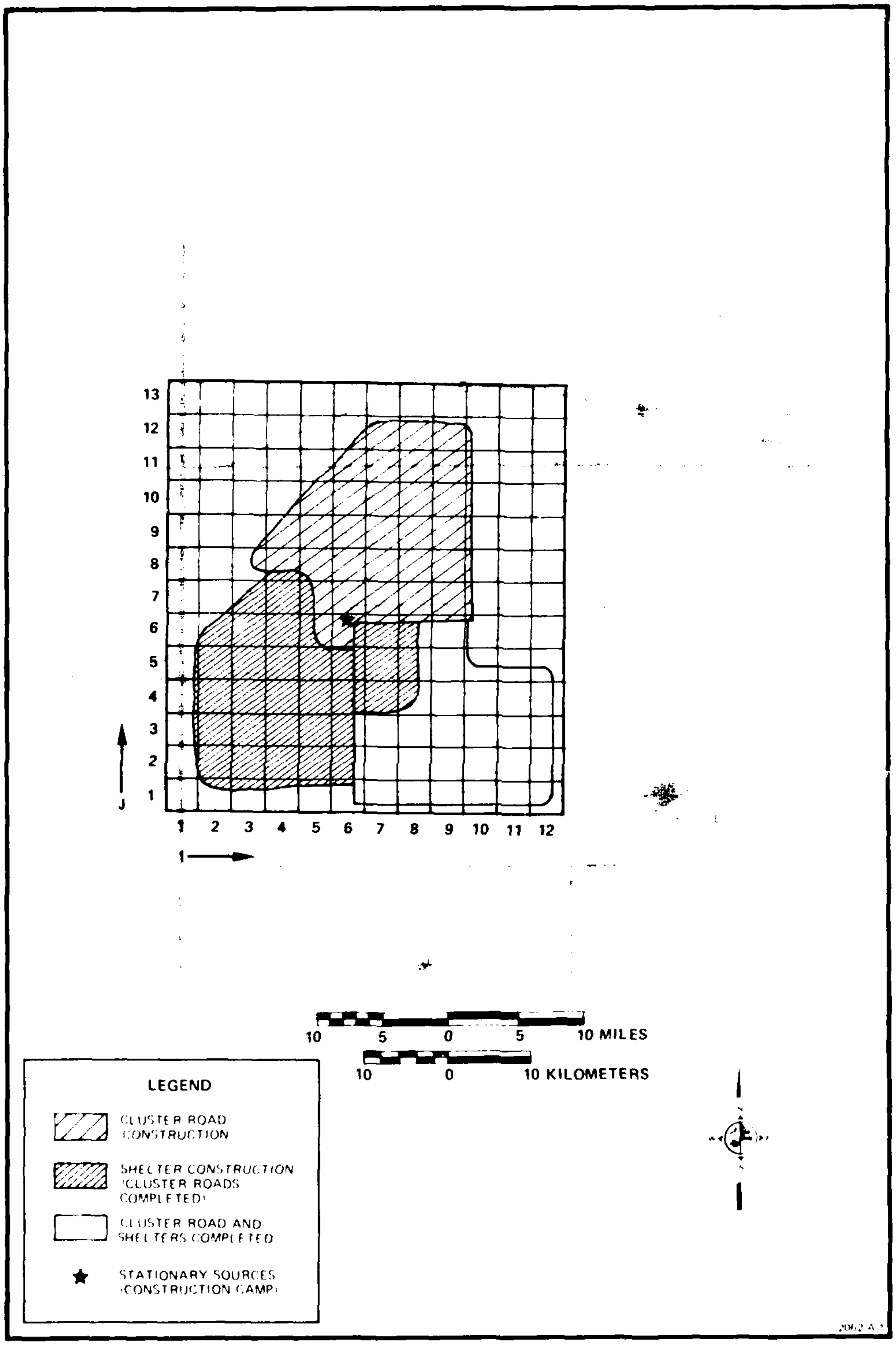


Figure 5.1.1-6. Emission grid for the Hereford, New Mexico construction group.

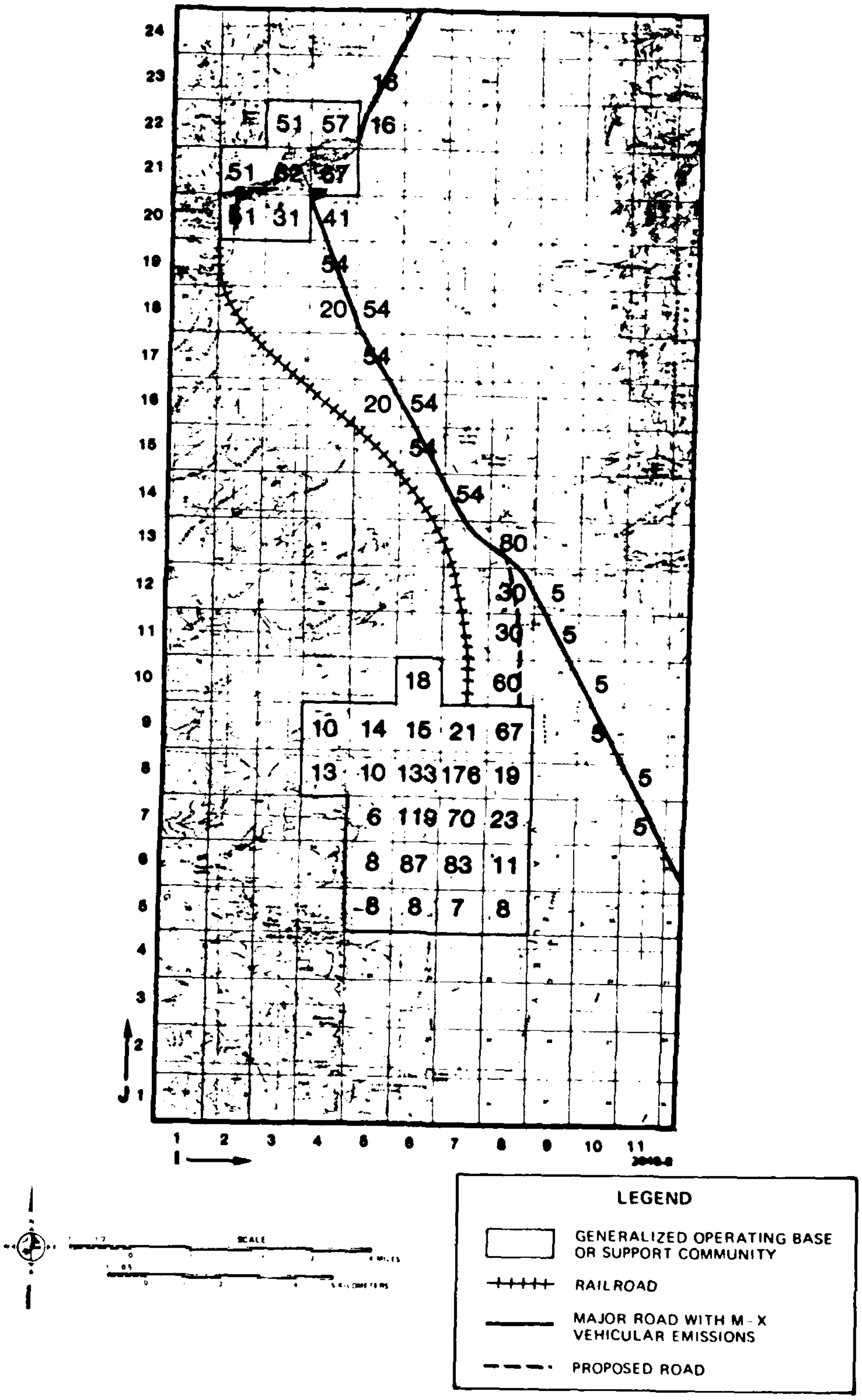


Figure 5.1.1-7. CO emissions and emission grid for the Ely OB site and community (emissions in g/sec).

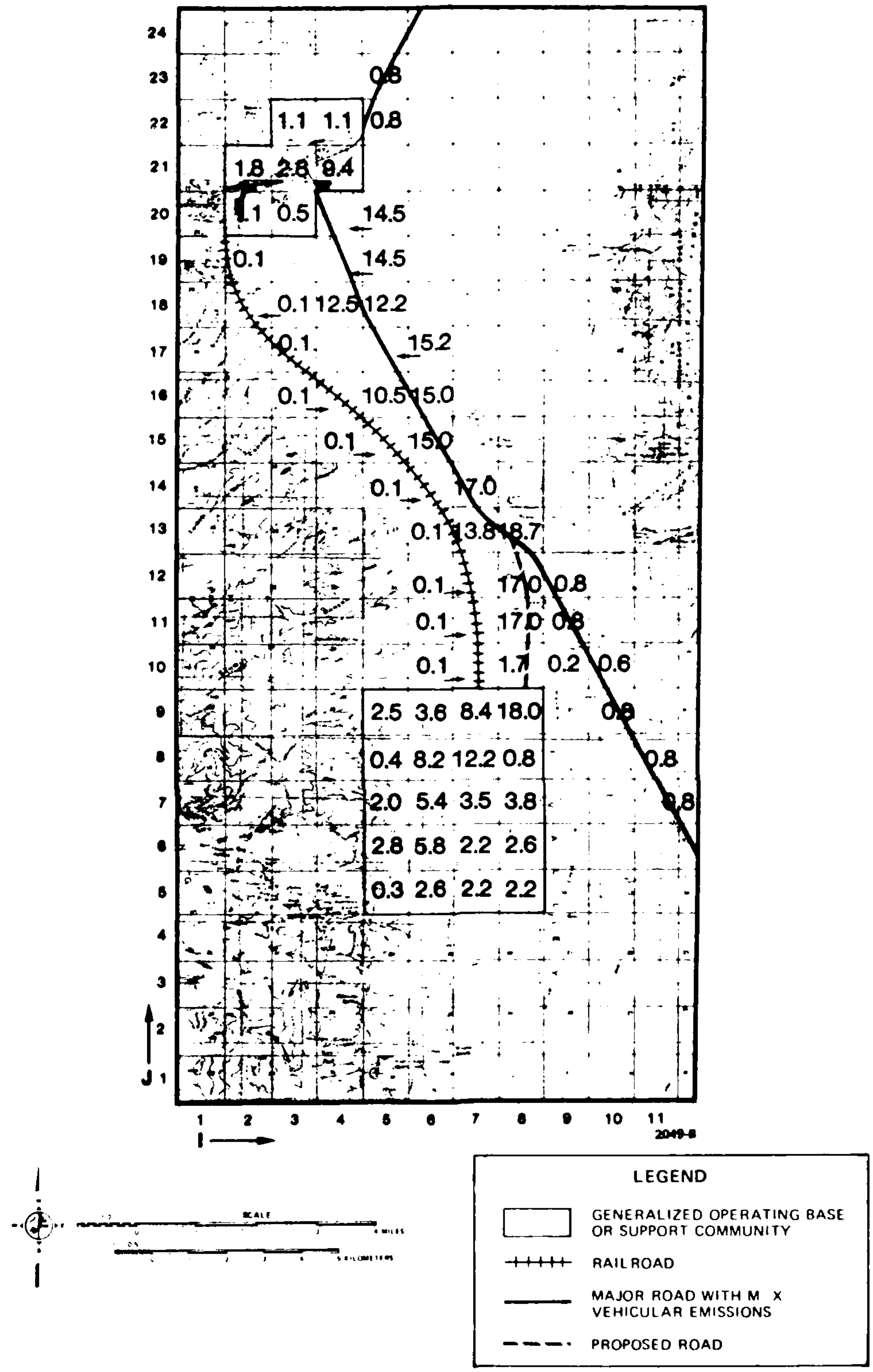


Figure 5.1.1-8. NO_x emissions and emission grid for the Ely OB site and community (emissions in g/sec).

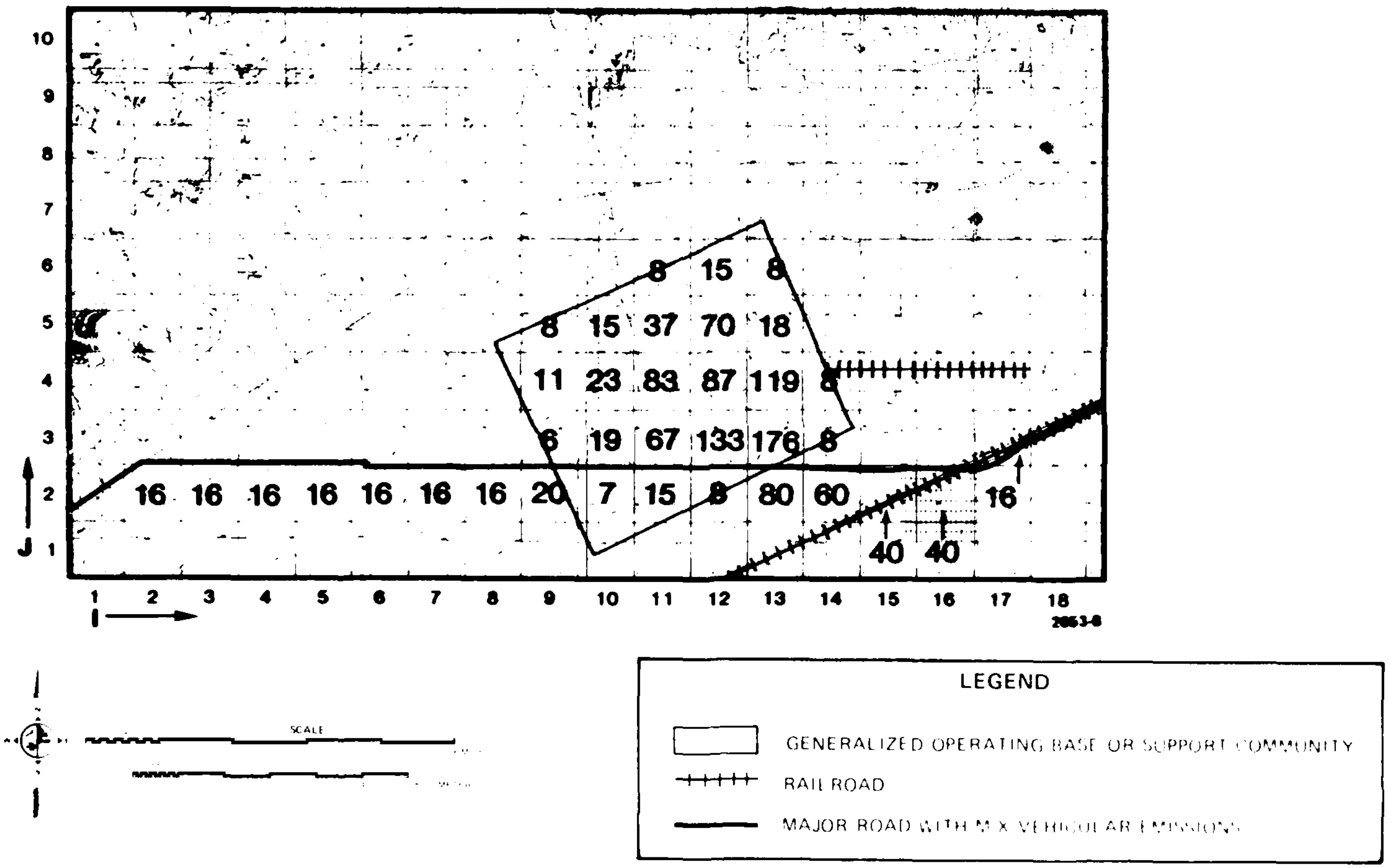


Figure 5.1.1-9. CO emissions and emission grid for the Beryl OB site (emissions in g/sec).

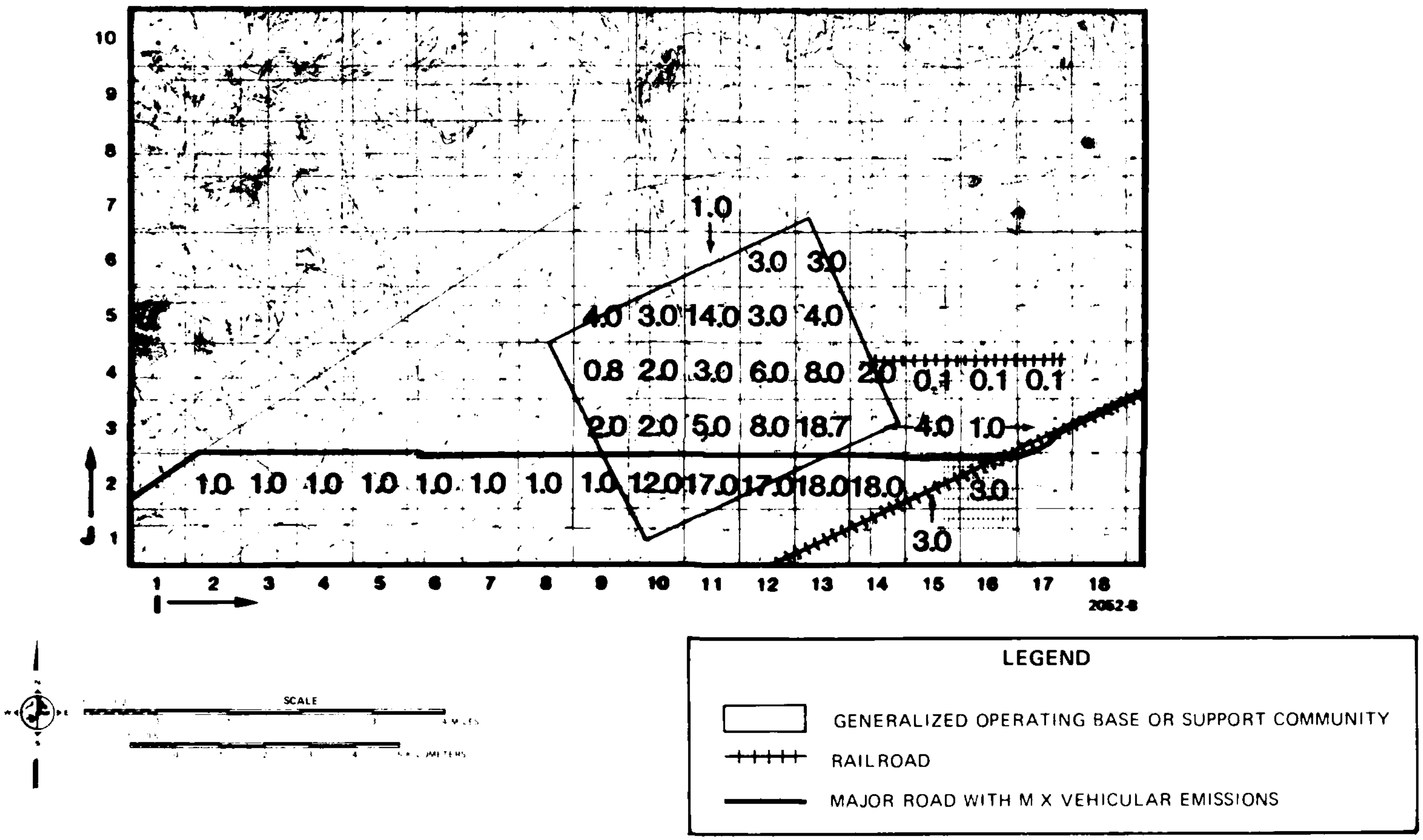


Figure 5.1.1-10. NO_x emissions and emission grid for the Beryl OB site (emissions in g/sec).

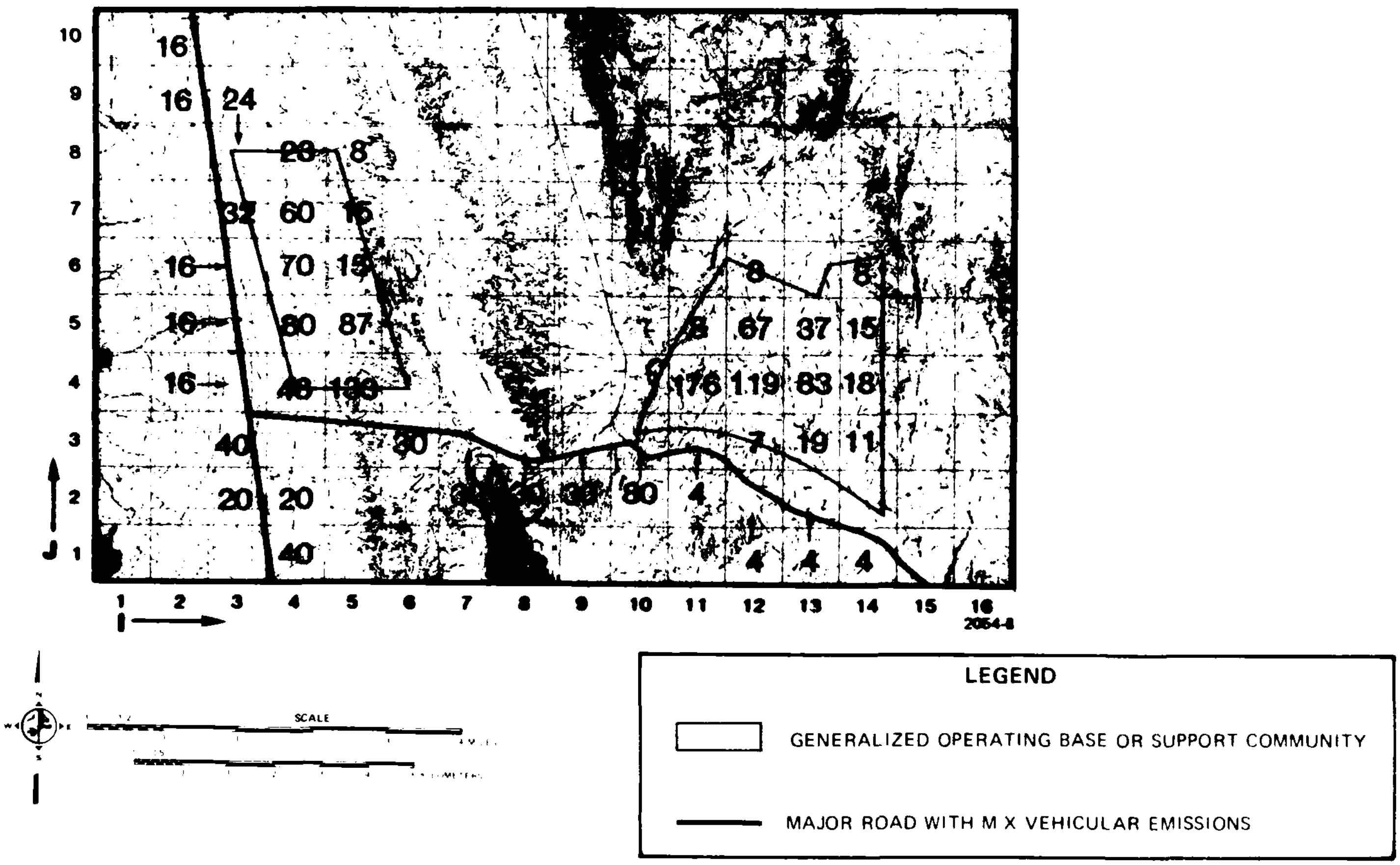


Figure 5.1.1-11. CO emissions and emission grid for the Coyote Spring OB site (emissions in g/sec).

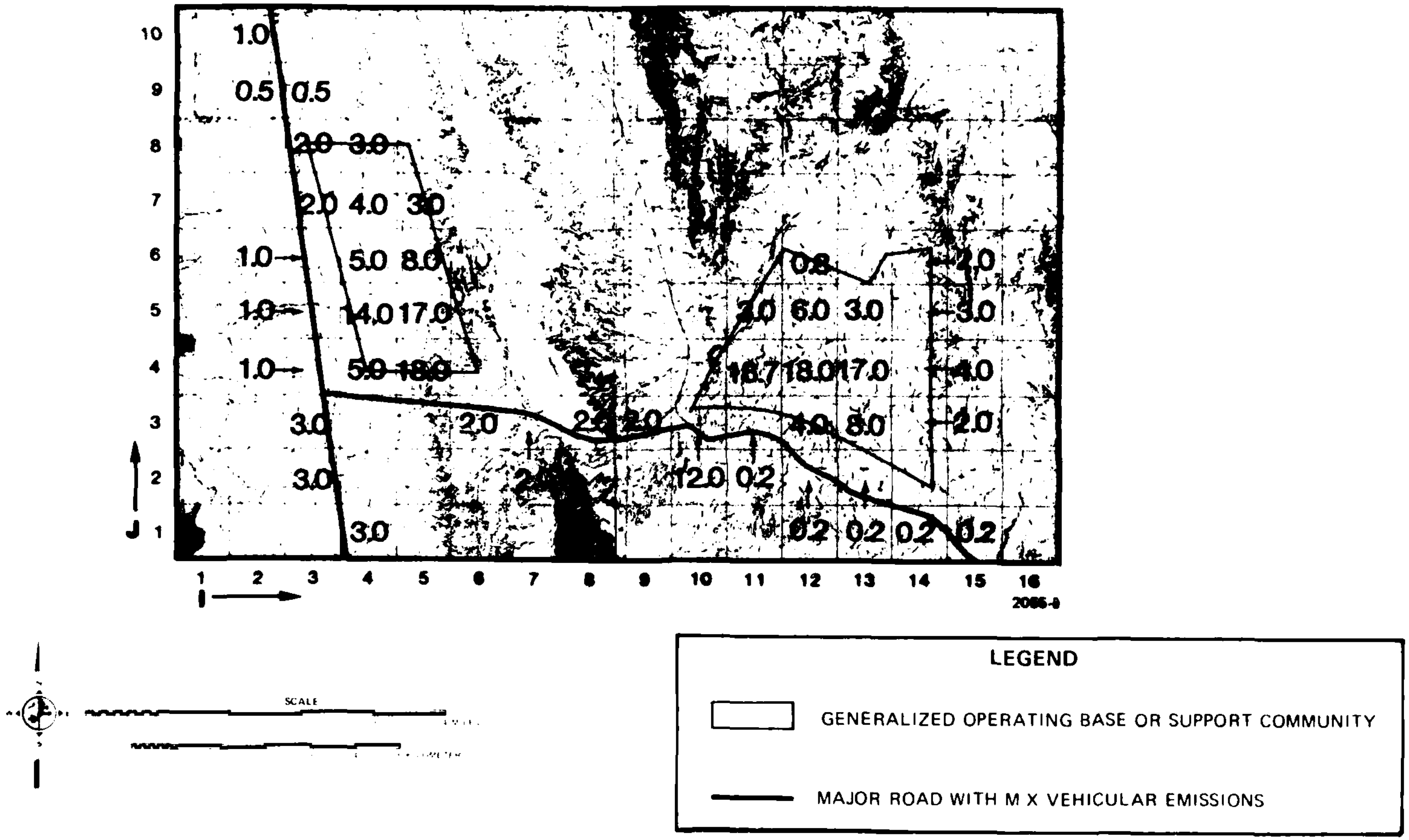


Figure 5.1.1-12. NO_x emissions and emission grid for the Coyote Spring OB site (emissions in g/sec).

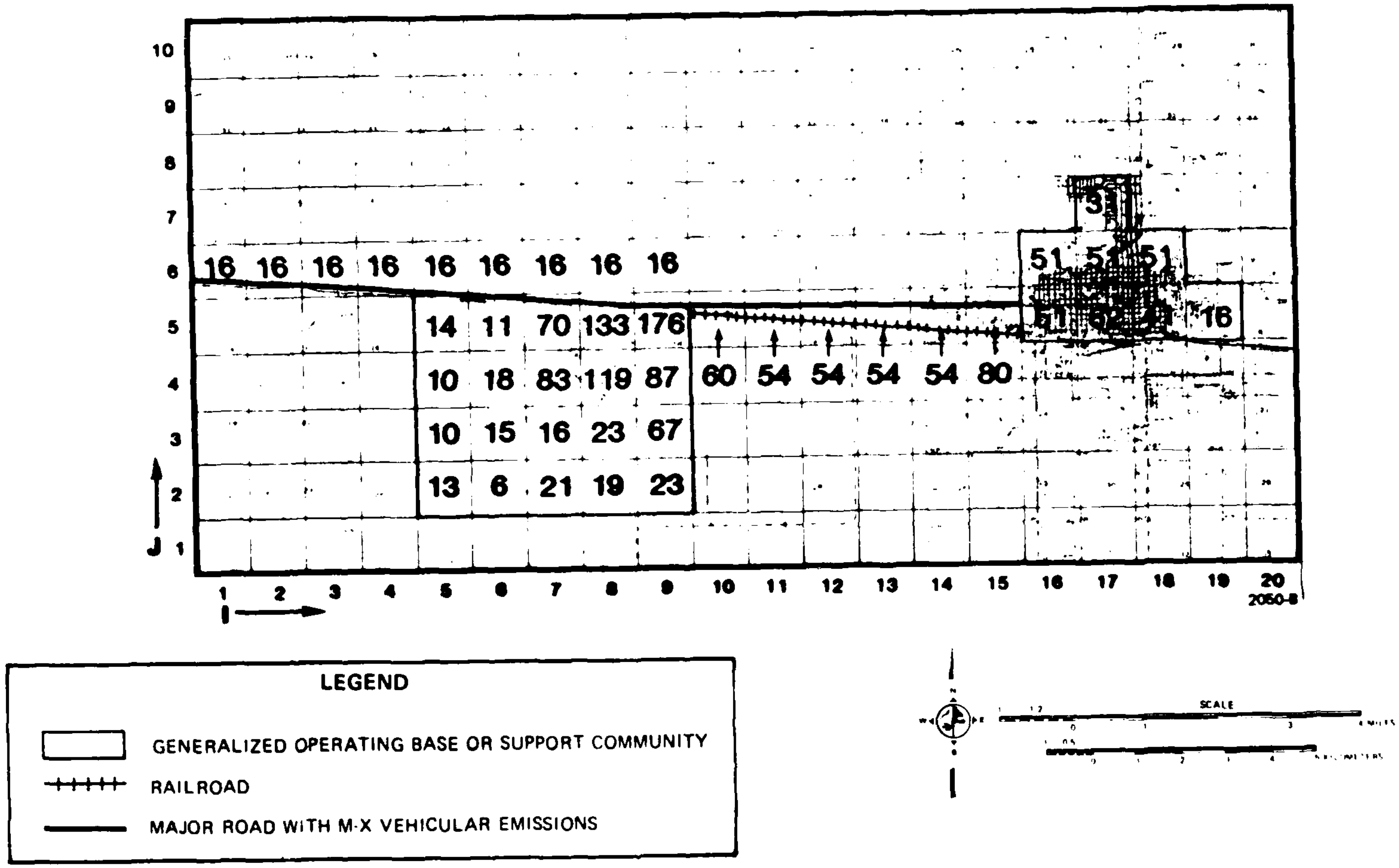


Figure 5.1.1-13. CO emissions and emission grid for the Clovis OB site and community (emissions in g/sec).

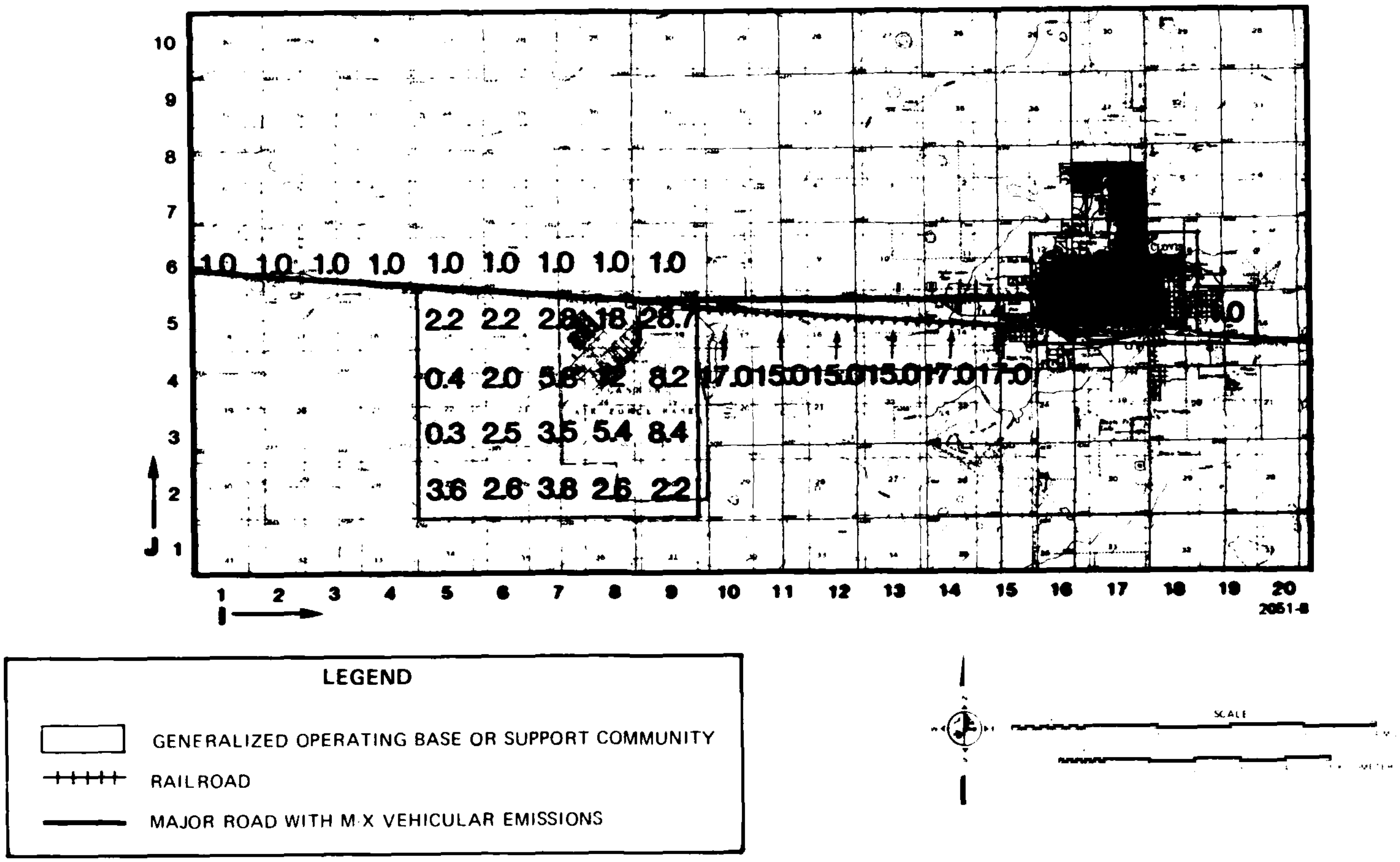


Figure 5.1.1-14. NO_x emissions and emission grid for the Clovis OB site and community (emissions in g/sec).

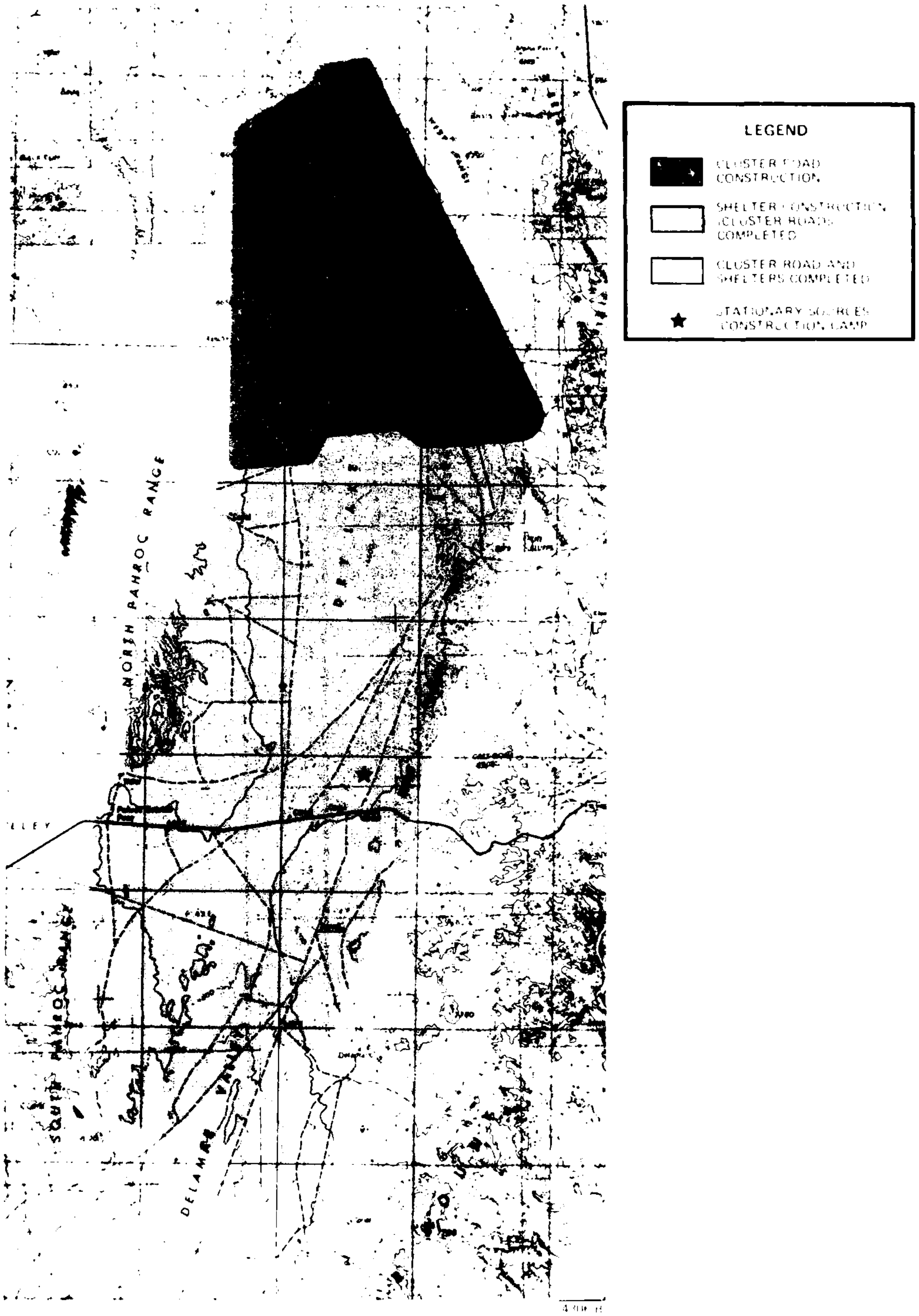


Figure 5.1.2-1. Terrain for the Dry Lake/Delamar area.

monoxide (CO), and hydrocarbons (HC). By far, the predominat pollutant emission during construction will be TSP, which occurs chiefly due to excavation, wind erosion, and vehicular traffic over cluster roads as well as from stationary sources producing road and shelter materials and aggregate storage piles. Particulate emissions during operation of the system will be greatly reduced and will consist chiefly of vehicle emissions from traffic over unpaved roads and from fugitive emissions from wind erosion of exposed surfaces.

Construction-Related Particulate Pollutant Impacts (5.1.3.1)

The effect on atmospheric resources of fugitive dust (particulate) emissions was assessed using the Integrated Model for Plumes and Atmospherics in Complex Terrain (IMPACT). The model was employed to predict regional (large scale) particulate concentrations resulting from cluster road and shelter construction. IMPACT is a three dimensional grid model capable of quantifying the effect of reactive and/or inert emissions. The model accounts for the influence of vertical temperature stratifications on wind and diffusion fields, and for shear flows created by the atmospheric boundary layer and terrain. The primary reason for choosing the non-Gaussian IMPACT model was its treatment of wind flows in regions with complex terrain. Gaussian models assume a wind flow that is uniform in direction and speed for each time period simulated (usually one hour). IMPACT is capable of more closely simulating actual wind flow patterns such as valley drainage winds, a condition typical of the hydrographic basins of Nevada and Utah. The IMPACT model uses topographic data to simulate geographic variations in wind speed and direction due to topographic influences throughout the modeled region. The highest pollutant concentrations are expected to result when valley drainage winds and a low inversion layer trap pollutants on the valley floor. Therefore, it was essential to be able to reasonably model the complexity of valley wind flows. The IMPACT model requires three types of data before performing an analysis for a given region: (1) meteorological data by location and time of occurrence, (2) emissions data by location and time of occurrence, and (3) digitized terrain data. Model input data are described in Sections 4.2.2, 5.1.1, and 5.1.2 respectively.

Estimates of particulate emissions during construction of the shelters, cluster roads, and DTN roads were calculated for several mitigation scenarios. Emission estimates were calculated for each construction group for the time period during construction when the level of construction activity and consequently the particulate emission rate was the highest.

Particulate emissions during construction will occur from stationary sources that produce and process construction materials for the roads and shelters (asphaltic concrete, aggregate, and bituminous surfacing), construction activities (blasting, excavation, and dirt moving), road dust from vehicular traffic over unpaved roads, and wind erosion of unpaved surfaces. Emission factors used to determine the emissions for each of the sources are given in Section 4.1.2.1 along with the calculated emission rates.

The probable-case emission scenario modeled incorporates the most likely physical conditions for soil and meteorology with a commonly applied combination of mitigative measures. Average vehicle speeds are 45 mph. The mitigative measures assumed include cost-effective control equipment for stationary sources that process or produce construction materials and watering of roads, aggregate

storage piles and construction activities. Watering is assumed to reduce emission rates by fifty percent.

Construction groups from the Nevada/Utah area were selected for air quality modeling that are either representative of a large set of construction groups, or that have unique emission, meteorological, or geographic characteristics.

Table 5.1.3-1 lists the construction groups that are selected for air quality modeling in Nevada and Utah.

The Dry Lake-Delamar construction group was selected for modeling because it is a topographically and meteorologically representative valley in the Nevada/Utah DDA and because it has a relatively large number of clusters, providing a conservative, or upper level, of emissions.

A construction time period with the highest regional activity level and therefore the highest regional dust emissions levels was selected to model. For example, the most intense construction activity period in Dry Lake-Delamar valleys occurs when five clusters are under shelter construction, five clusters are under cluster road construction, the DTN road is completed and oiled, and only one cluster is fully constructed.

Probable emissions for the Delta configuration group are of the same type as those used for the Dry Lake-Delamar group. The emissions are distributed to the appropriate grid cells according to the expected activity rate. Cluster road construction, which is dustier than shelter construction, was placed in the clusters nearest Delta to determine the effects on the town during the most intense construction activity period expected.

The Duckwater area was selected to model because of the configuration of a small number of clusters within a narrow valley. All clusters were assumed to have cluster road construction activity, which produces more dust emissions than shelter construction.

The meteorological conditions modeled in the IMPACT code for the Delamar-Dry Lake Valley are presented for representative hours in Section 4.2.2. Site- specific meteorological data were not available. Stability data were therefore extracted from studies which determined lapse rates from soundings in the Nevada Test Site, an area of Nevada similar to the Delamar-Dry Lake region. A typical pattern of early morning inversion, breaking up in midmorning, followed by mostly neutral conditions with some low level thermal instability in the afternoon, was used as the modeling condition. This pattern was coupled with typical valley wind conditions determined by subjective analysis. In general it was assumed that low-level winds would be flowing downslope in the early morning hours, and as the valley floor begins to warm, the wind shifts to an up-valley direction and the speed increases. Afternoons are generally characterized by moderate speed winds flowing up through the valley which die down and begin to shift again as the sun sets and the valley begins to cool.

The conditions simulated for the Duckwater, Nevada, area represent a case of flow reversal. In the morning mountain drainage winds were postulated to flow to the south, while in the afternoon the higher speed, dominant, northward regional flow

Table 5.1.3-1. Construction groups in Nevada and Utah selected for air quality modeling.

Name	Hydrographic Basin No.	No. of Clusters In Group
Dry Lake-Delamar	181 & 182	11
Delta	46	11
Duckwater	173B	3

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of air was presumed to have established itself. The stability pattern was similar to that used in Delamar-Dry Lake.

For Delta, Utah, a simulation was made of "worst-case" conditions under which the town of Delta would receive dust pollutants. The worst-case wind pattern is considered infrequent; the normal meteorological conditions for the area would generally result in only very low, if any, impact on the town. A pattern of eastward airflow from 8:00 a.m. through noon was modeled, with slow winds in the early hours becoming stronger later in the morning.

Modeling results for Delamar-Dry Lake, Delta and Duckwater using mitigated emission rates are presented in Table 5.1.3-2. The highest and second highest 24-hour concentrations are reported for each area. The results are based on a 12-hour simulation for Delamar-Dry Lake, and on 4 (worst) hour simulations for Duckwater and Delta.

These results may be viewed as conservative due to the fact that, once emitted, all particulate material was assumed to remain suspended for the remainder of the simulation period, when in reality some resettling of material would occur even though the particles modeled are less than 30 in diameter (EPA, 1977). The assumption of continuous suspension yields artificially high emission rates, hence conservative model results.

The highest concentration reported for each of the three areas occurs in the immediate vicinity of the batching and aggregate storage facilities (the major stationary emission source). The second highest levels result from shelter and road construction, and are more representative of the fugitive dust concentrations at locations near the heavy construction. The town of Delta received a maximum concentration of 25 micrograms per cubic meter. The results in Table 5.1.3-2 show that under the conditions modeled, second highest concentrations for all three areas modeled in Nevada/Utah are less than the secondary 24-hour NAAQS ($150\ \mu/m^3$), but are greater than the 24-hour PSD increment for Class II areas ($37\ \mu/m^3$). The PSD increment is used here as a bench mark for comparison purposes only, since construction emissions are not subject to PSD review. Figures showing the construction scenarios and the distribution of the hourly particulate concentrations for the areas modeled are presented in Section 5.1.5.

It should be noted that the concentrations reported by the IMPACT model are values averaged over a 4 km by 4 km area (one grid cell), hence higher levels than those reported for an entire grid cell would occur directly adjacent to areas of high construction activity within the grid cell.

The IMPACT model is adequate for assessing concentrations on a regional scale, given the lack of site specific meteorological data and refined emissions scenarios. The PAL and ISC models were used to predict close-in dust impacts due to construction activity. The results are presented in Sections 5.3 and 5.4. Using the PAL model, it is predicted that within 100 meters of a construction site the particulate concentrations would exceed established air quality standards (see Table 5.1.3-3), even with maximum mitigation.

Table 5.1.3-2. Particulate matter concentrations resulting from construction. (24-hour average values).

Location	Highest Concentration Micrograms/Cubic Meter	Second Highest Concentration Micrograms/Cubic Meter
Delamar/ Dry Lake	84[1]	43[2]
Delta	59[1]	36[2]
Duckwater	88[1]	55[2]

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[1]Maximum concentration occurs in vicinity of construction camp area. See Figures 5.1.1-1, 5.1.1-2, 5.1.1-3.

[2]Second highest concentration occurs in areas of most active cluster road construction. See Figures 5.1.1-1, 5.1.1-2, 5.1.1-3.

Note: Average concentrations for 24 hours were obtained by adding the hourly concentrations which occurred during construction, to the hourly concentrations during the non-working hours, due to M-X-related wind erosion from exposed surfaces. Utah's primary 24-hour standard for TSP is 260 $\mu g/m^3$, Nevada's primary 24-hour standard for TSP is 150 $\mu g/m^3$. The 24-hour Class II PSD increment is 37 $\mu g/m^3$.

Table 5.1.3-3. Applicable ambient air quality standards.

POLLUTANT	AVERAGING TIME	NAAQS		NEVADA STANDARDS
		PRIMARY	SECONDARY	PRIMARY
Total Suspended Particulate Matter	Annual (Geometric Mean)	75 $\mu g/m^3$	60 $\mu g/m^3$ [2]	75 $\mu g/m^3$
	24-hour[2]	260 $\mu g/m^3$	150 $\mu g/m^3$	260 $\mu g/m^3$
Lead	Quarterly (Arithmetic Mean)	1.5 $\mu g/m^3$	Same as primary standard	Same as NAAQS

728-1

[1]All Utah standards are equivalent to NAAQS.

[2]Secondary annual TSP standard (60 $\mu g/m^3$) is a guide for assessing State Implementation Plans.

[3]Not to be exceeded more than once per year.

Operation-Related Gaseous Pollutant Impacts (5.1.3.2)

The primary air quality concern during the operation of the OB will be the increase in levels of CO, NO_x, and hydrocarbons (HC) due mainly to traffic, space heating/cooling, and fuel storage and handling. Increased carbon monoxide levels will be due primarily to the vehicle emissions; NO_x levels are due to more a general class of emitters including both vehicles and space heating, and HC emissions result from vehicle traffic as well as an evaporation fuel storage. Emissions of NO_x and HC are important precursors to the formation of photochemical oxidants.

The emission levels for each of the OB sites were scaled from available emissions data gathered at Vandenberg Air Force Base, and distributed to appropriate locations on the expected operations base configurations (see Section 5.1.1). Vandenberg Air Force Base was deemed as being adequately representative of a typical OB site in terms of facilities, population, and types of operations. Some modifications to base layouts have occurred since the time of modeling, but the changes are not expected to significantly alter the regional concentration results predicted by IMPACT using 4,000 ft by 4,000 ft grid squares.

A direct analysis of the potential OB emissions leading to oxidant formation was not possible due to the lack of specific data on HC levels. Based on rough estimates of total NO_x emissions, it is possible that photochemical oxidants could be formed given a sunny day, a stable atmosphere, low wind speeds, and a sufficient amount of reactive hydrocarbons. Comprehensive emissions data for the OB, to be collected during subsequent tiered decisionmaking is needed to quantify the potential NO_x problem. Based on the fact that small, isolated communities (<5,000 people) do not generally experience high oxidant levels, an oxidant problem is not expected at the operating base. However, it is not possible to precisely quantify the potential effect at this time. Analyses of SO_x and TSP emissions were not possible because no major sources of these pollutants were identified. Plans to build a central cooling and heating facility are currently under consideration. A detailed emissions inventory for the OB will be proposed during subsequent tiered decision-making. Additional air quality modeling can also be conducted for the OB during subsequent tiering if any potentially significant sources are identified.

For general operational emissions, the IMPACT model was run for the two gaseous pollutants, CO and NO_x, that were considered to be significant based on preliminary analysis. The potential OB sites of Beryl, Coyote Spring, and Ely were selected for modeling. Due to similarities between the Beryl site and the sites of Milford and Delta, the dispersion modeling results obtained for Beryl and vicinity were considered adequate to describe potential air quality impacts of equivalent activity increases for Milford or Delta.

The IMPACT model results show that CO reached peak hourly concentrations of 2.3, 1.6, and 2.5 parts per million (ppm) for Beryl, Coyote Spring, and Ely, respectively, (see surface plots in Section 5.1.5). The peak values of both CO and NO_x occurred during the early morning hours between 7 a.m. and 10 a.m., when light winds and stable atmospheric conditions result in poor pollutant dispersion. These CO maximum hourly values are well below the federal, Nevada, and Utah standards, and no significant adverse impacts are therefore anticipated on a regional level. Close-in impacts to busy roadways were modeled using HIWAY (see Section 5.2).

Maximum one-hour NO_x concentrations predicted by the model were 0.18, 0.20, and 0.13 ppm for Beryl, Coyote Spring, and Ely (see surface plots in Section 5.1.5). These values are greater than the federal, Nevada, or Utah annual standard of 0.05 ppm; however, the one-hour peak value is of short duration and not expected to be of sufficient magnitude to contribute to a violation of the overall annual level. For comparison purposes, the California 1-hour NO_2 standard is 0.25 ppm. This value is not exceeded at any of the OB locations modeled. Information on long-term emission rates will be required to confirm this expected lack of long-term significant impact.

PREDICTED POLLUTANT CONCENTRATIONS - TEXAS/NEW MEXICO (5.1.4)

Construction-Related Particulate Pollutant Impacts (5.1.4.1)

Construction areas from Texas/New Mexico selected for air quality modeling were either representative of a large set of construction groups, or were located close to population centers.

Construction groups near Clovis, New Mexico, and Dalhart and Hereford, Texas, were selected for study in the Texas/New Mexico DDA. A construction time period when the highest regional dust emission rates are produced was modeled. All construction groups have identical total emission rates because of an identical number of clusters included. The distribution of emissions and their orientation with respect to sensitive receptors (for example, towns and cities) is different for each area modeled. The most intensive construction activity time period occurs when cluster road construction proceeds within five cluster areas, shelter construction occurs within five clusters and construction is completed in three clusters. A construction camp with corresponding stationary sources is planned for each construction group.

The areas modeled in the Texas/New Mexico deployment area (Hereford, Clovis, and Dalhart) are of similarly flat terrain. Because of this characteristically flat terrain, significant cold air drainage winds, common in the valley areas of Nevada/Utah, do not occur in the Texas/New Mexico study area. Thus, the wind fields of both morning and afternoon are relatively uniform throughout the study region, generally exhibiting a flow towards the ENE. Morning wind speeds for the hours 8:00 to 10:00 a.m. were assumed to be approximately 2 m/sec, and the late morning winds were assumed to increase to average speeds of 6 m/sec. Ground level inversions were assumed for 8:00 a.m. and 9:00 a.m. At 10:00 a.m. the inversion rose above 100 m; and at 11:00 a.m. the atmosphere was presumed to have become neutral. Meteorological conditions modeled were selected for the Hereford, Texas area and for both Dalhart, Texas and Clovis, New Mexico (see Section 4.2.2).

Modeling results for Clovis, Hereford, and Dalhart are presented in Table 5.1.4-1. The highest and second highest concentrations are reported for each area. The 24-hr concentrations are based on the results of a 4-hr simulation done for each area.

The highest concentration reported for each of the three areas occurs in the immediate vicinity of their respective batching and aggregate storage facilities (the major stationary emission source). The second highest levels result from shelter and road construction and are more representative of the fugitive dust concentrations at

Table 5.1.4-1. Fugitive dust concentrations resulting from construction (24-hour average values).

Location	Highest Concentration Microgram/Cubic Meter	Second Highest Concentration Microgram/Cubic Meter
Clovis	50[1]	38[2]
Dalhart	54[1]	35[2]
Hereford	72[1]	64[2]

T2279/10-2-81

[1]Maximum concentration occurs in vicinity of construction camp area. See Figures 5.1.1-4, 5.1.1-5, 5.1.1-6.

[2]Second highest concentration occurs in areas of most active cluster road construction. See Figures 5.1.1-4, 5.1.1-5, 5.1.1-6.

Note: Average concentrations for 24 hours were obtained by adding the hourly concentrations which occurred during construction to the hourly concentrations during the non-working hours due to M-X-related wind erosion from exposed surfaces. Texas' and New Mexico's 24-hour standard for TSP is 150 $\mu g/m^3$. The 24-hour Class II PSD increment is 37 $\mu g/m^3$.

locations near heavy construction sites. Under the conditions modeled there would be no violation of the secondary 24-hour national air quality standard (Table 5.1.4-2). Second highest predicted concentrations at Clovis and Hereford (38 and 64 μg/m^3 respectively) were greater than the 24-hour Class II PSD increment (37 μg/m^3). The PSD increment is used here as a benchmark only as temporary construction emissions are not subject to PSD review. These results may be viewed as conservative, since all particulate material emitted was assumed to remain suspended for the remainder of the simulation period. In reality, some resettling of material would occur. (EPA, 1977). The assumption of continuous suspension yields artificially high emission rates and correspondingly conservative model results.

The IMPACT model is considered adequate for assessing concentrations on a regional scale. Concentrations reported by the IMPACT model are values averaged over a 4 km by 4 km area (one grid cell). Higher levels than those averaged over an entire grid cell are predicted to occur directly adjacent to areas of high construction activity within the grid cell (see Sections 5.3 and 5.4). It is predicted that within 100 m of a construction site the particulate concentrations would exceed national air quality standards, even with maximum mitigation. During construction, the only personnel in the immediate vicinity of construction would be those associated with the project. The OSHA standard for worker exposure of 5,000 μg/m^3 for respirable dust and 15,000 μg/m^3 for total dust (29 CFR 1910.1000) will not be exceeded (see Section 5.4).

The only fugitive dust emissions in individual deployment areas during normal operation will be from wind erosion and the vehicular traffic necessary for system security and maintenance. Entrainment of dust caused by vehicles moving over the paved and unpaved roads of the deployment area is not expected to be significant because of the low traffic level forecast for normal system operation. Wind erosion emissions are discussed in Sections 4.1.2.1.5 and 5.5.

Operation-Related Gaseous Pollutant Impacts (5.1.4.2)

Gaseous emissions resulting from construction or operation of the M-X system are not expected to cause significant deterioration of existing air quality in the Texas/New Mexico deployment area. The major gaseous emissions which would be of concern are carbon monoxide, nitrogen oxides, sulfur dioxide, and hydrocarbons. These criteria pollutants would be emitted mainly during fuel combustion processes. Heavy-duty vehicles and generators burning diesel fuel would be the largest source of emissions for the construction phase of the project. Preliminary data indicate that private vehicles and space heating/cooling units would be the major emitters during systems operation. Plans to build a central cooling and heating facility (CCHF) in place of individual facility units is also under consideration.

The IMPACT model was used to model regional dispersal and resulting concentrations of CO and NO_x around the Clovis, New Mexico OB site. Due to topographical and meteorological similarities between the Clovis site and the Dalhart, Texas OB site, the modeling results obtained for Clovis and vicinity were considered adequate to describe potential air quality impacts of equivalent activity increases at Dalhart.

The emission levels for each of the OB sites were scaled from data gathered at Vandenberg Air Force Base and redistributed to appropriate grid cells on the expected operations base configurations (see Section 5.1.1).

Table 5.1.4-2. Summary of National Ambient Air Quality Standards (NAAQS) and Texas/New Mexico Ambient Air Quality Standards.

Pollutant	Averaging Time	NAAQS Primary	NAAQS Secondary	Texas Standards	New Mexico Standards
Total Suspended Particulate Matter	Annual (Geometric Mean)	75 ug/m^3	60 ug/m^3 [1]	Same as NAAQS	60 ug/m^3
Total Suspended Particulate Matter	24-hour [2]	260 ug/m^3	150 ug/m^3	150 ug/m^3	150 ug/m^3
Total Suspended Particulate Matter	1-hour [3]	--	--	400 ug/m^3	N/A
Total Suspended Particulate Matter	3-hour [3]	--	--	200 ug/m^3	N/A
Total Suspended Particulate Matter	5-hour [3]	--	--	100 ug/m^3	N/A
Lead	Quarterly (Arithmetic Mean)	1.5 ug/m^3	--	Same as NAAQS	Same as NAAQS

T769/9-18-81/F

[1] Secondary annual NAAQS TSP standard (60 ug/m^3) is a guide for assessing state implementation plans.

[2] Not to be exceeded more than once per year.

[3] Not to be exceeded any time by any single major stationary source or group of sources located on contiguous property.

The IMPACT model results show that CO reached a peak hourly concentration of 1.3 ppm average for a 4 km square grid cell (see surface plots in Section 5.1.5). This maximum hourly value for CO is well below the federal, Texas, and New Mexico standards and no significant adverse regional impact is therefore expected. The HIWAY model was used to predict pollutant concentrations at receptor points near busy roadways.

The maximum one-hour NO_x concentration averaged over a grid cell by the model was 0.11 ppm, which, while greater in magnitude than the federal, Texas, or New Mexico annual standard of 0.05 ppm, is of short duration. Annual NO_x concentrations are anticipated to be significantly less than the peak hourly values. For sake of comparison, it is noted that the California 1-hour NO_x standard is 0.25 ppm, which is considerably higher than the peak modeled value of 0.11 ppm. Long-term meteorological data is necessary in order to make annual concentration predictions. A monitoring program to record data at several OB sites has begun as part of future tiered decisionmaking. Peak local concentrations for CO, NO_x, and HC near busy roadways are modeled using HIWAY (see Section 5.2). Preliminary data do not indicate any major SO_x emission sources at the OB. More refined emissions data can be made available based on the OB design during the future tiered decisionmaking. At that time, additional modeling will be conducted as appropriate.

PRESENTATION OF IMPACT MODELING RESULTS (5.1.5)

The incremental concentration levels predicted by the IMPACT model are shown, on an hourly basis, in the form of isolines over topographic maps. Areas in which various modes of construction or system operation occur are outlined and shaded according to an identifying legend given on the figure. Again, the construction configuration indicated on the figures and used in the model represents a time period where the highest *particulate emission rates* are expected for that construction group. The numbers on the figure correspond to predicted regional incremental levels of pollutant concentration due to the M-X system. The predictions are given on an hourly basis and values can be seen to change from hour to hour dependent mainly on the meteorologic conditions of wind and stability. In comparing the output results with the input hourly meteorological conditions it can be seen that the highest concentrations occur during the hours of low wind with a stable atmosphere, conditions which contribute to poor pollutant dispersal. Concentrations generally flow and build up along the predominant wind direction under conditions of a low, steady wind and high stability which prevent upward dispersal. High winds also blow pollutants along the direction of flow, but tend to disperse and dilute the pollutants, thereby lowering concentrations.

The areas modeled for construction impacts exhibit the highest concentrations of particulates in the vicinity of stationary sources at the construction camp since this is an area of high activity and intense emission rates. The next highest area of concentration is associated with the part of the system which is undergoing construction of cluster roads and shelters simultaneously. Large numbers of vehicles are operating within this part of the system, but because of the large area in which they are spread out, the emission concentrations are not as high as around the relatively small stationary source area with its high density of vehicles and activity. The lowest levels of pollutant concentration are found around the inactive areas of the system in which wind erosion from previously disturbed surfaces is the only source of emissions.

The modeling of the OB locations for gaseous pollutant concentrations demonstrated a similar pattern of levels for each site. The highest concentrations were found around the main gate areas of the OB due to the high traffic volume predicted there, and the next highest levels were found spread out along the road connecting the support community and the base. These findings are quite reasonable since the majority of emissions are vehicle-related and the greatest vehicle traffic will occur between the major population center and the main gate.

The surface plots of the construction modeled sites of Dry Lake-Delamar, Duckwater, Delta, Clovis, Dalhart, and Hereford are presented in Figures 5.1.5-1 through 5.1.5-32. Surface plots for the modeled OB sites of Ely, Beryl, Coyote Spring, and Clovis are given as Figures 5.1.5-33 through 5.1.5-60.

5.2 HIWAY MODELING RESULTS

The EPA HIWAY line source model was used to predict gaseous pollutant concentrations due to vehicular traffic associated with system construction and OB operation.

CONSTRUCTION-RELATED VEHICULAR IMPACTS (5.2.1)

The largest gaseous emission rate during construction was found to be 8,000 lb/day (3,628 kg/day) for NO_x. This 8,000 lb/day rate is predicted in a cluster road construction area when one hundred percent of the allocated cluster road construction equipment was operating. Normally within a segment of operations, the cluster road equipment is expected to be spread out over a work area of five cluster systems at any one time. However, for preliminary analysis it was assumed that all of the daily emissions would be concentrated within a working area encompassing only one cluster system (i.e., on a roadway system of approximately 35 mi or 56 km). The emission rate per unit distance therefore becomes 229 lb/day/mi (104 kg/day/mi).

Assuming that all emissions occur during an eight-hour construction day, an emission factor is calculated as follows:

$$\frac{104\ \text{kg}}{\text{mile-8 hr}} \times \frac{1000\ \text{gram}}{1\ \text{kg}} \times \frac{1\ \text{mile}}{1{,}609\ \text{meters}} \times \frac{1\ \text{hour}}{3{,}600\ \text{second}} = \frac{0.0023\ \text{gram}}{\text{second-meter}}$$

This emission rate was input into an EPA-approved line source dispersion model, HIWAY, for a four kilometer section of cluster roadway. Low wind speed and E class Pasquill stability were used as conditions to assure conservative estimates. The results shown in Table 5.2-1, indicated that at a distance of 50 meters to the line source, the NO_x concentration had dropped to a level of 519 g/m^3. This is an hourly measure which cannot be directly compared to the federal annual standard of 100 g/m^3. As a benchmark the California 1-hour standard of 470 g/m^3 can be compared to this models value. However, the actual annual average would be a fraction of the federal standard because the HIWAY output value of 519 g/m^3 represents a conservative condition case occurring only on construction days and only during construction hours.

Emission rates calculated for the other gaseous pollutants of concern were even lower than these of NO_x. The rate of emission of carbon monoxide was the next highest value at 3,400 lb/day (1,542 kg/day), less than half the rate of NO_x

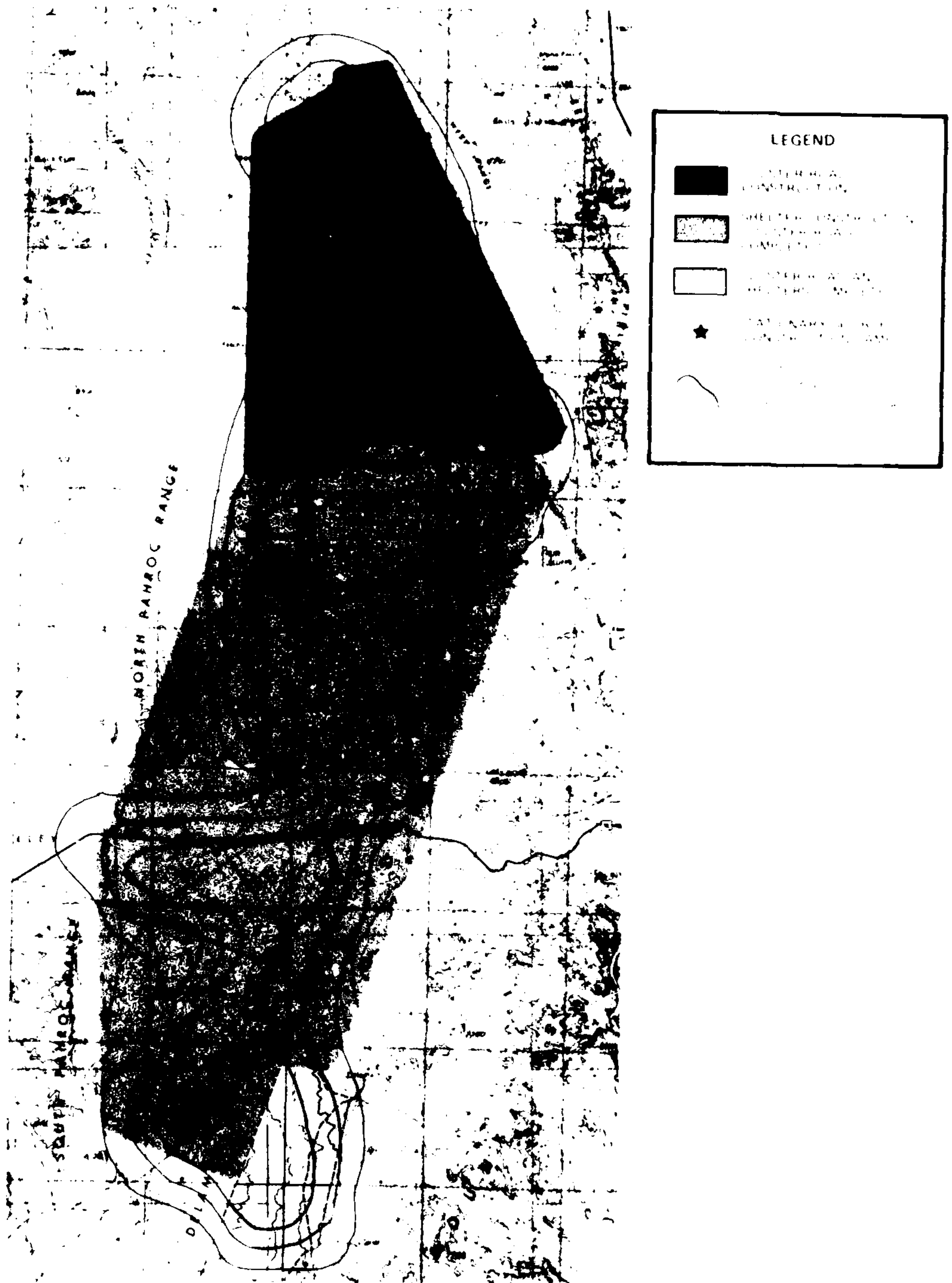


Figure 5.1.5-1. Predicted hourly particulate concentrations due to the construction of shelters and cluster roads, Dry Lake-Delamar valleys.

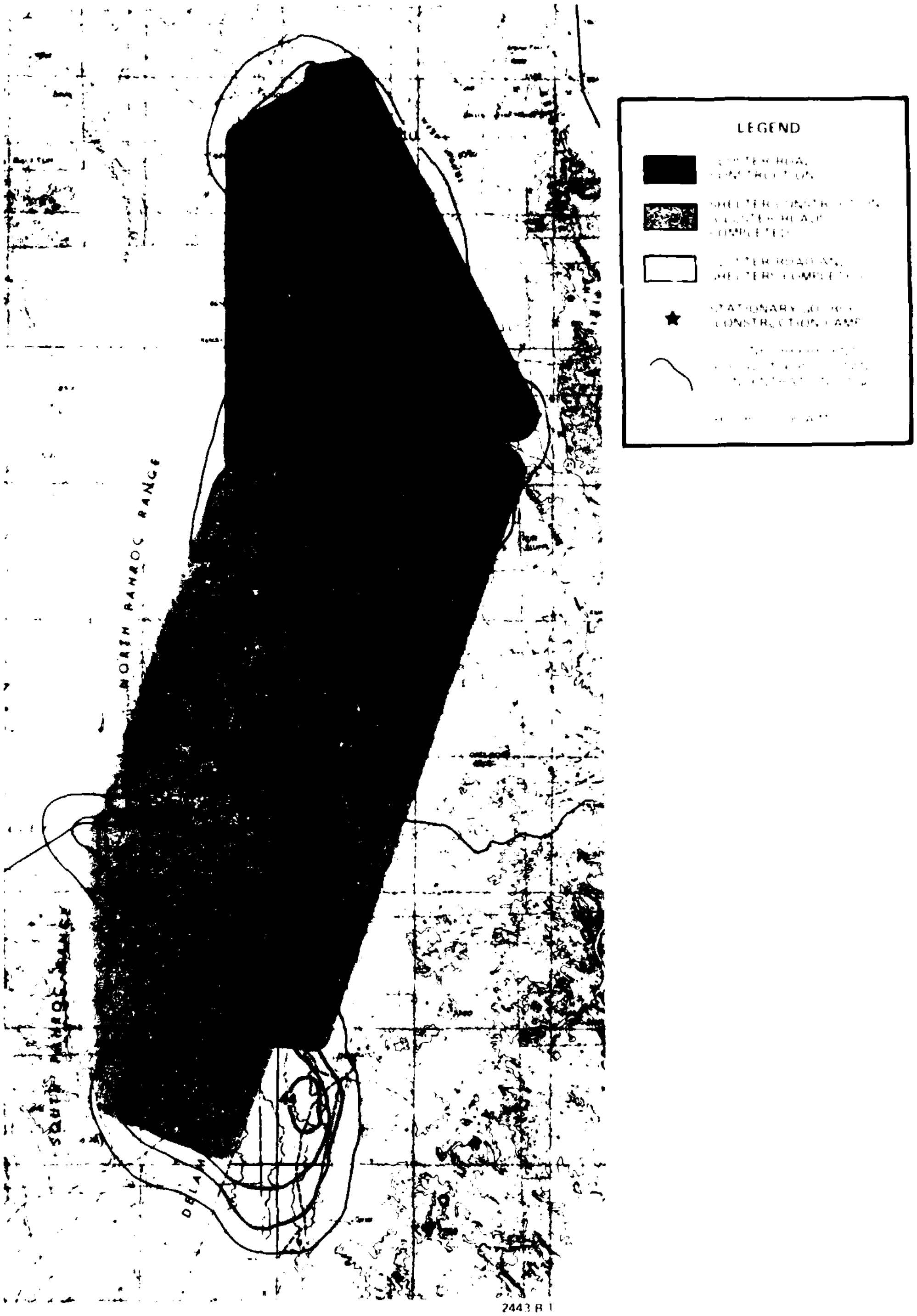


Figure 5.1.5-2. Predicted hourly particulate concentrations due to construction of shelters and cluster roads, Dry Lake/Delamar valleys.

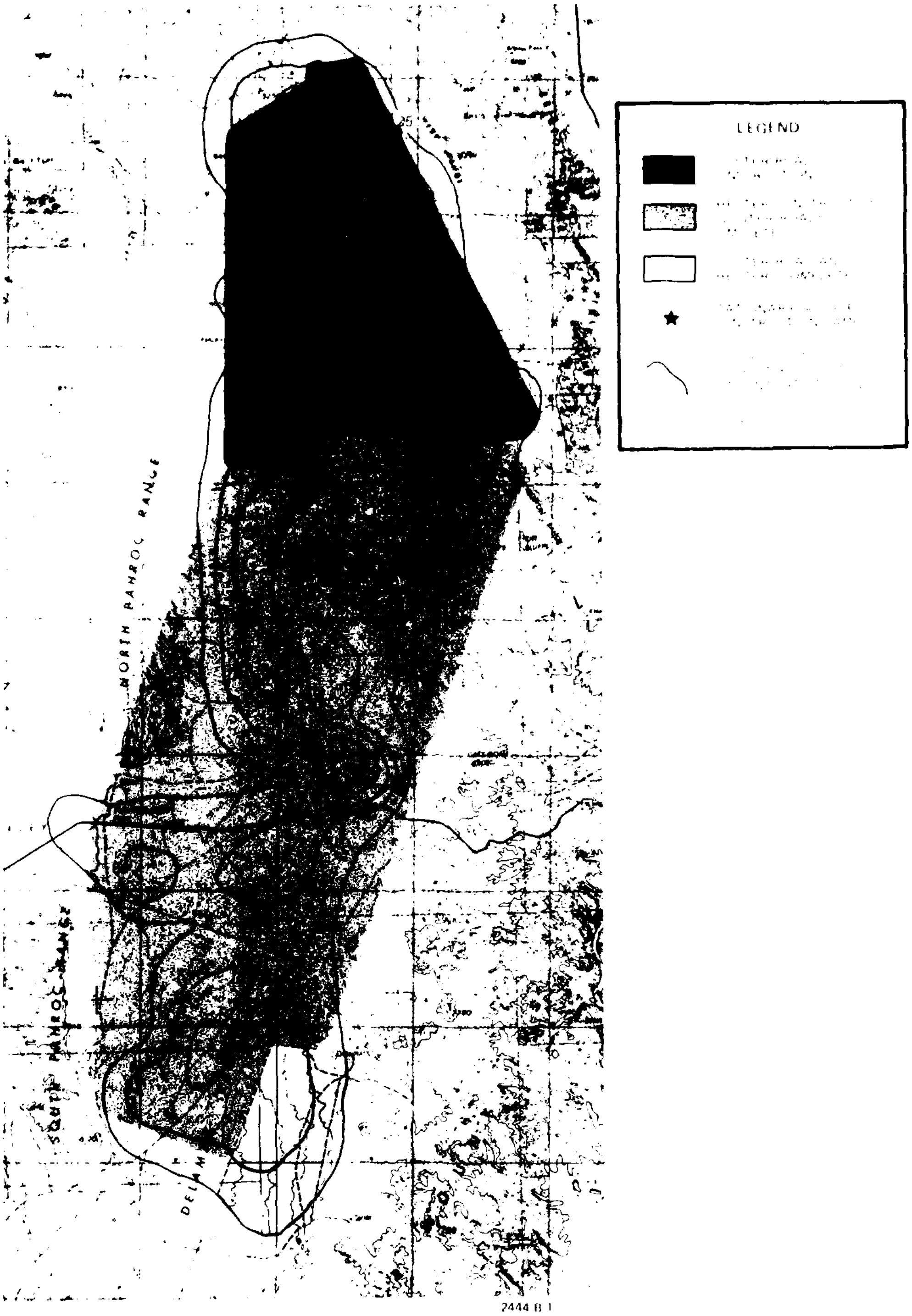


Figure 5.1.5-3. Predicted hourly particulate concentrations due to construction of shelters and cluster roads, Dry Lake/Delamar valleys.

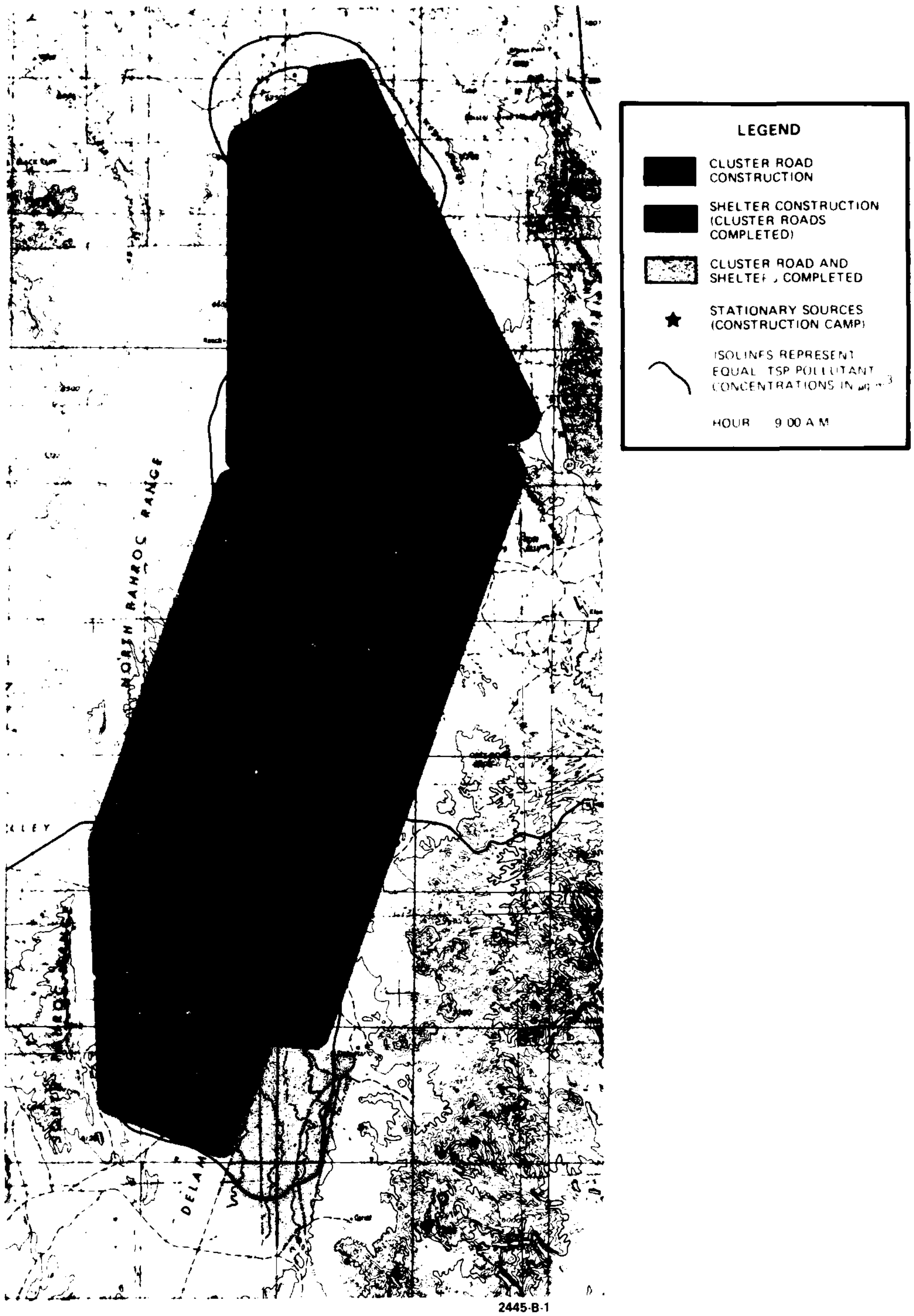


Figure 5.1.5-4. Predicted hourly particulate concentrations due to construction of shelters and cluster roads, Dry Lake/Delamar valleys.

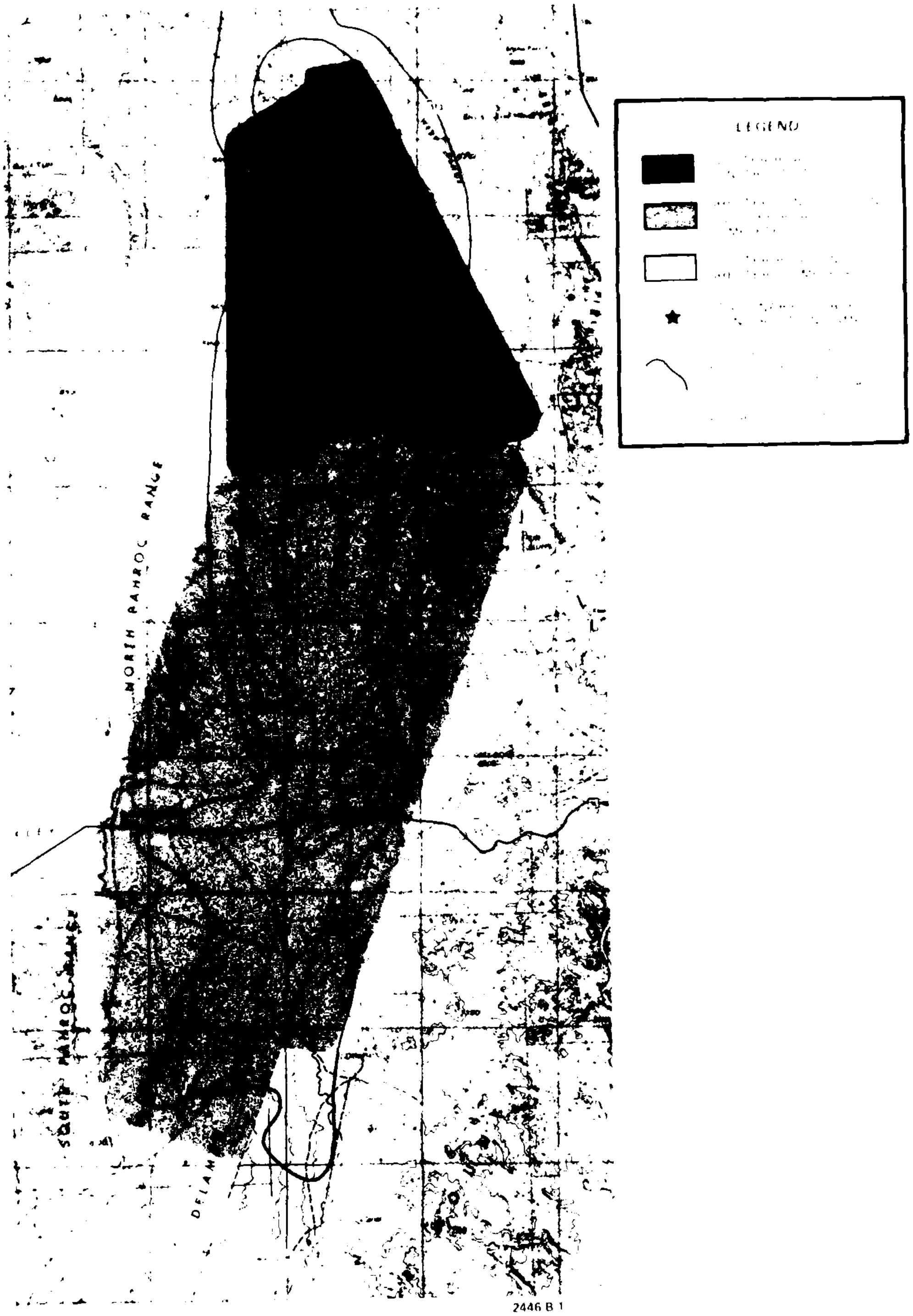


Figure 3.1.5-5. Predicted hourly particulate concentrations due to construction of shelters and cluster roads, Dry Lake/Delamar valleys.

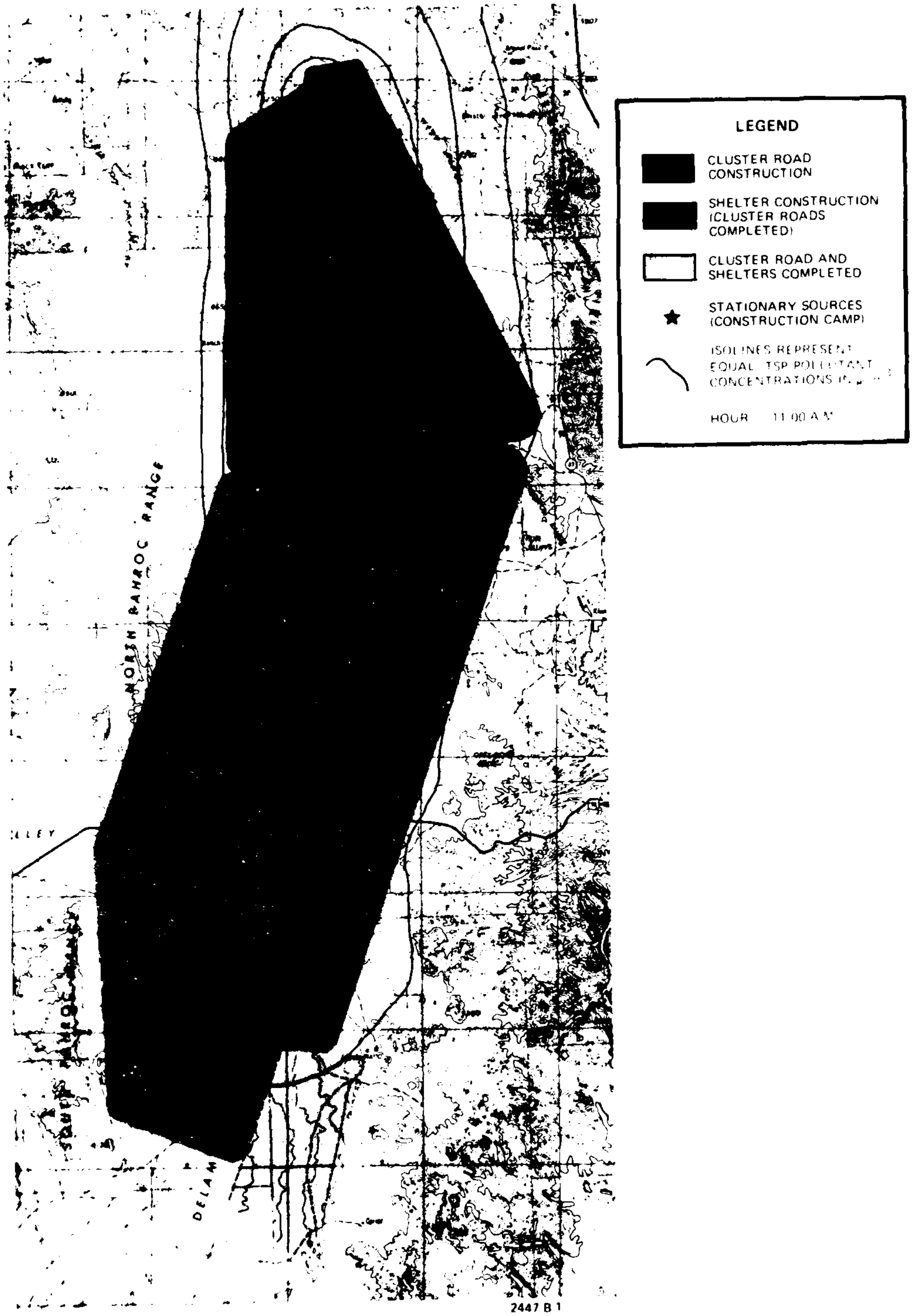


Figure 5.1.5-6. Predicted hourly particulate concentrations due to the construction of shelters and cluster roads, Dry Lake/Delamar valleys.

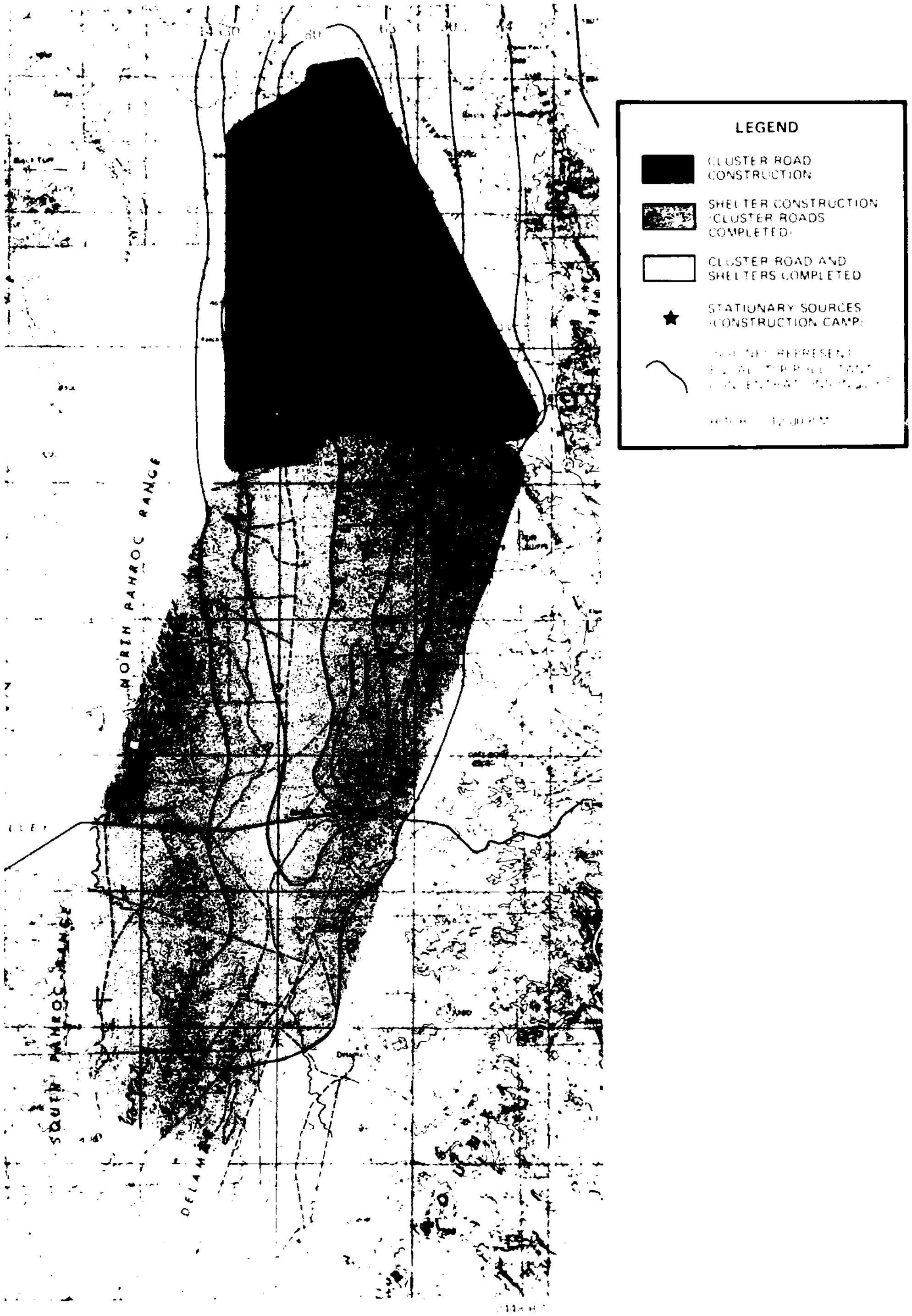


Figure 5.1.5-7. Projected hourly particulate concentrations due to construction of shelter and cluster roads in Lake-Delamar Valleys.

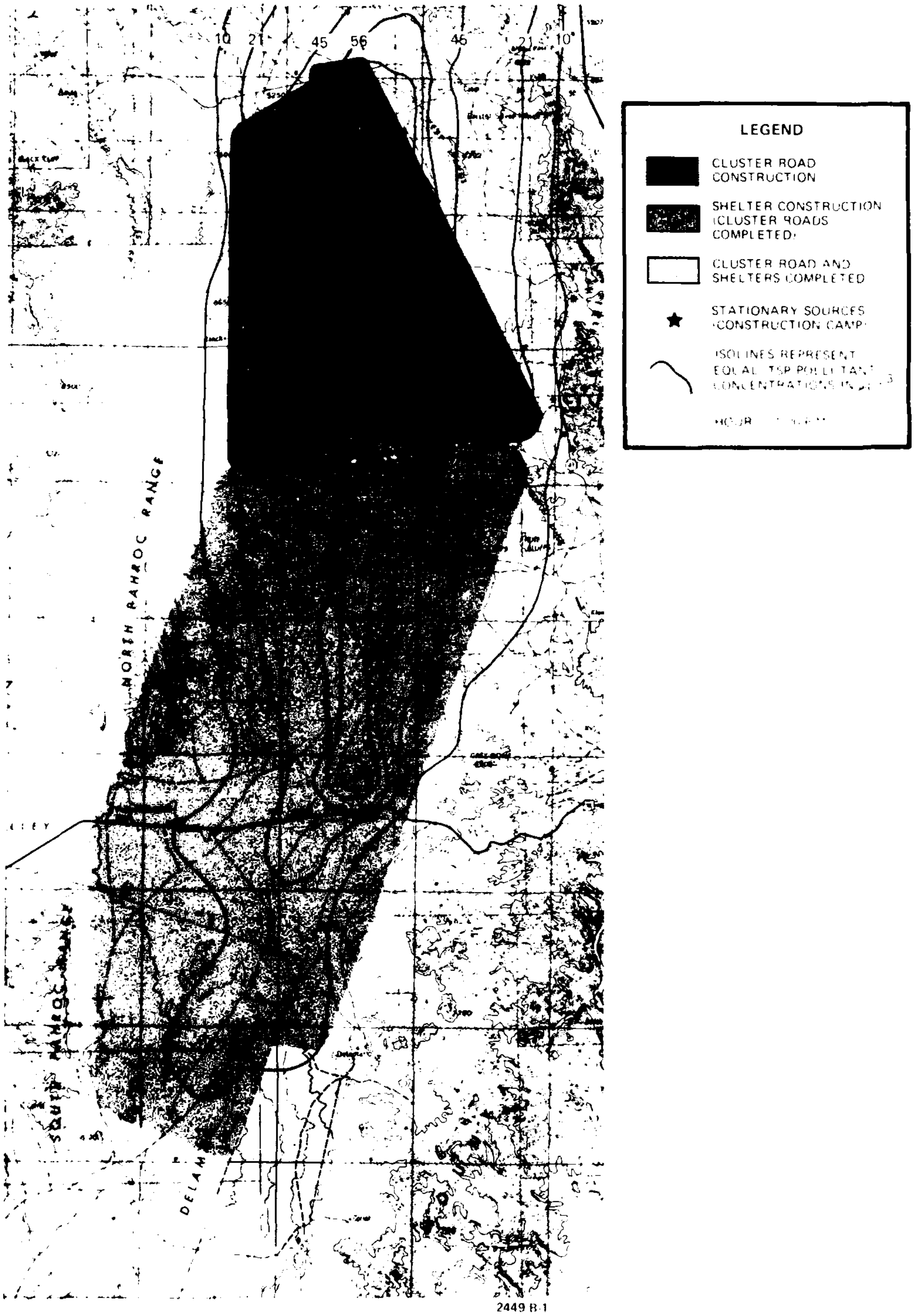


Figure 5.1.5-8. Predicted hourly particulate concentrations due to construction of shelters and cluster roads, Dry Lake/Delamar valleys.

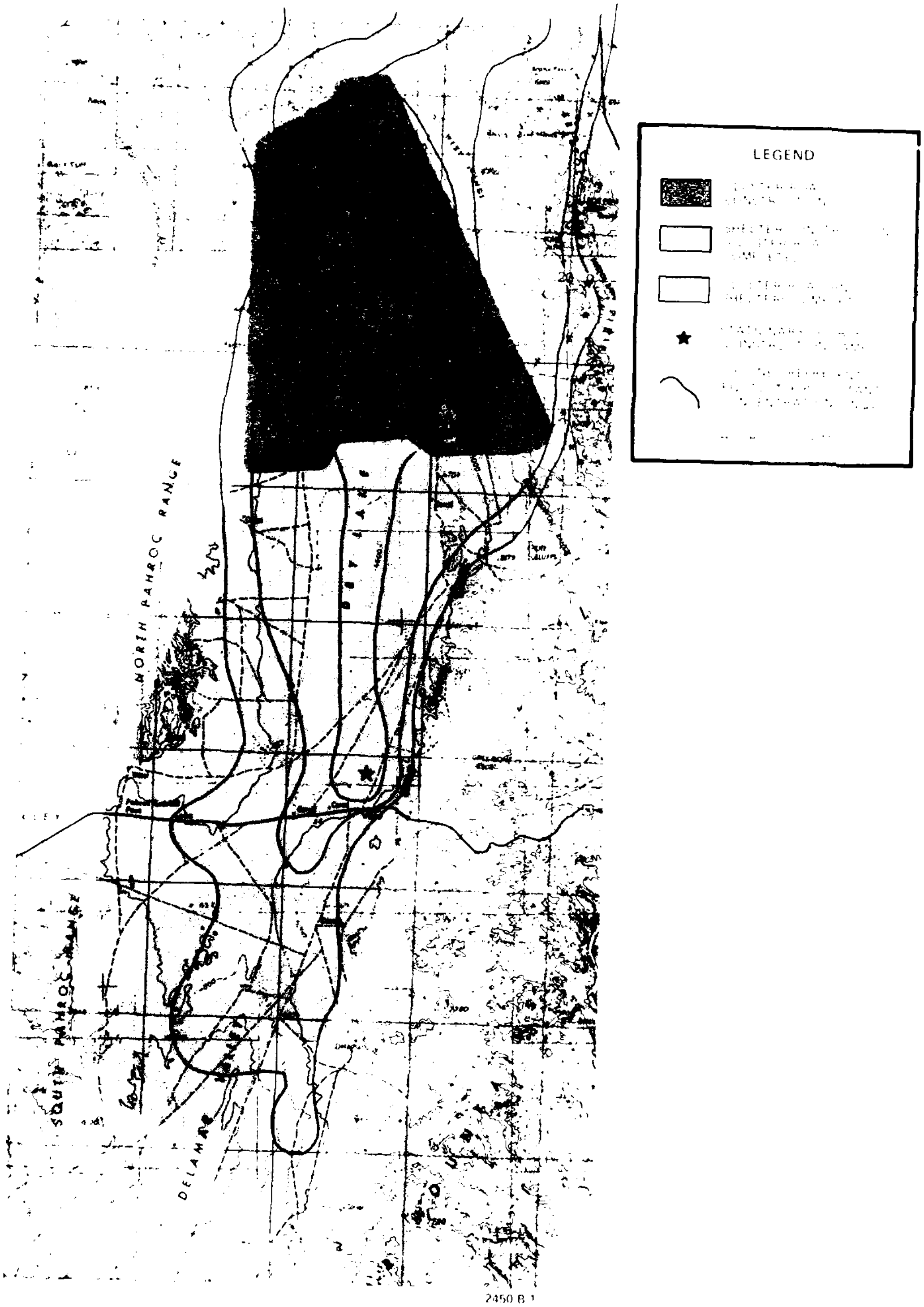


Figure 5.1.5-9. Predicted hourly particulate concentrations due to construction of shelters and cluster roads, Dry Lake/Delamar valleys.

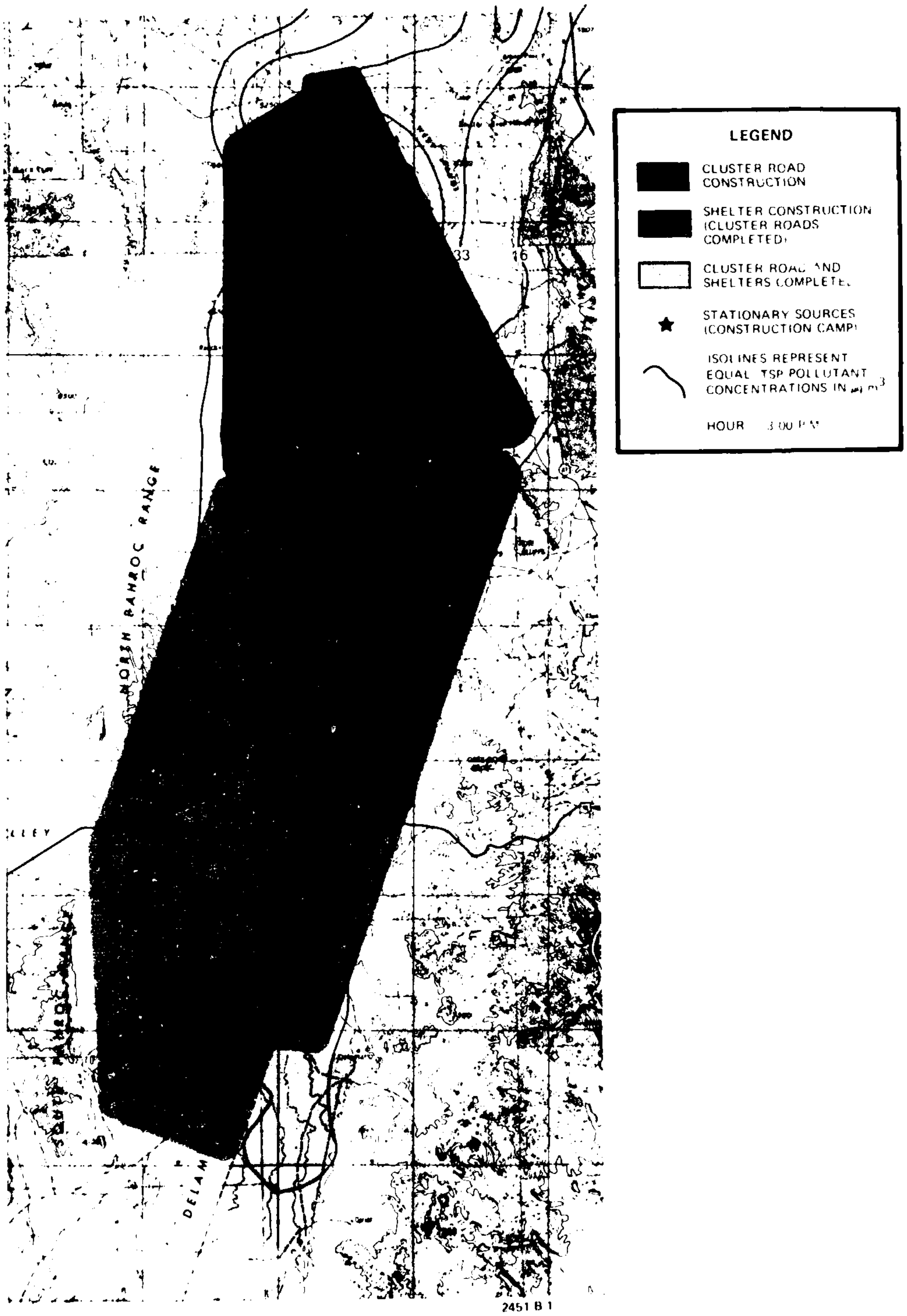


Figure 5.1.5-10. Predicted hourly particulate concentrations due to construction of shelters and cluster roads, Dry Lake/Delamar valleys.

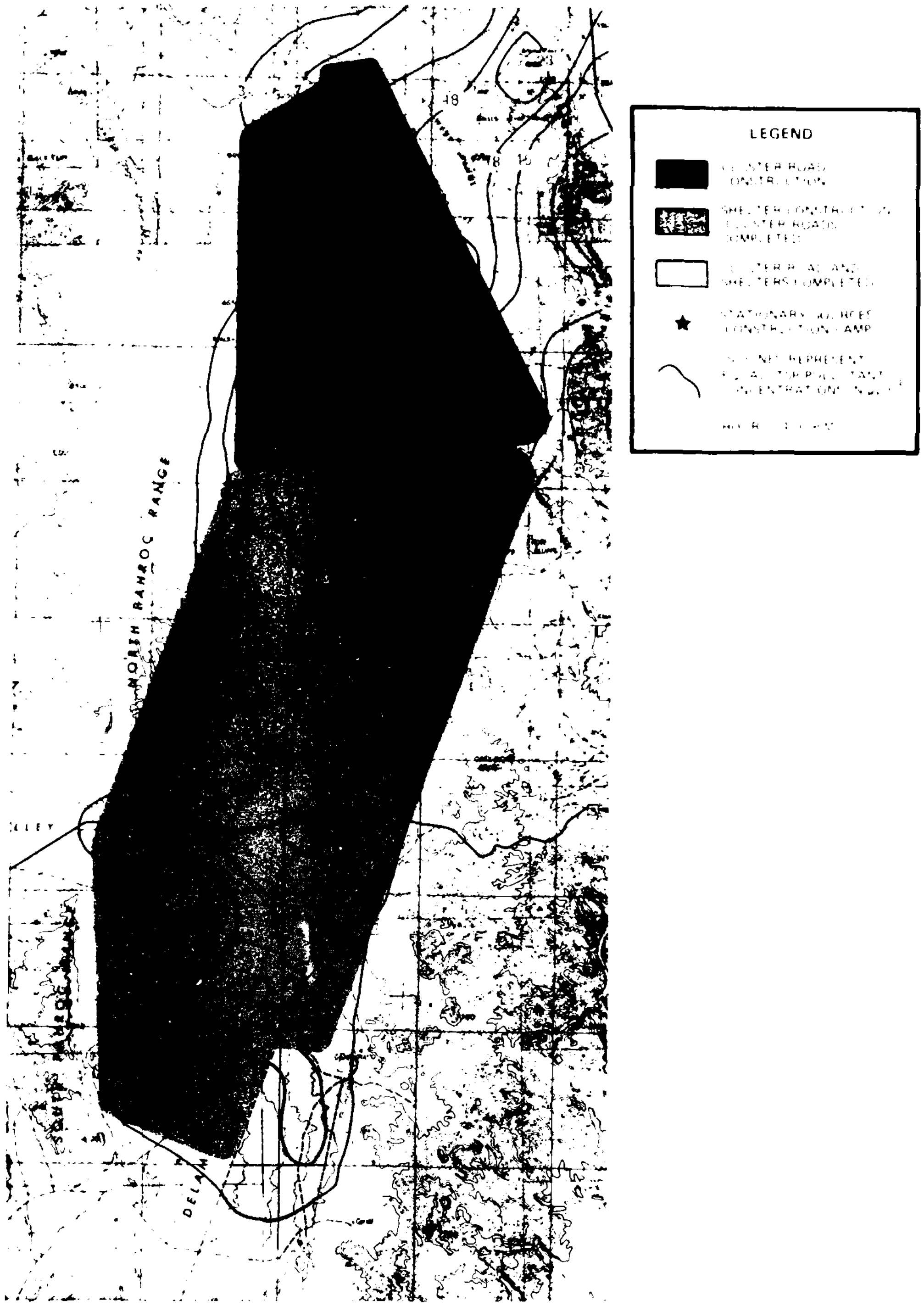


Figure 5.1.5-11. Predicted hourly particulate concentrations due to construction of shelters and cluster roads, Dry Lake/Delamar valleys.

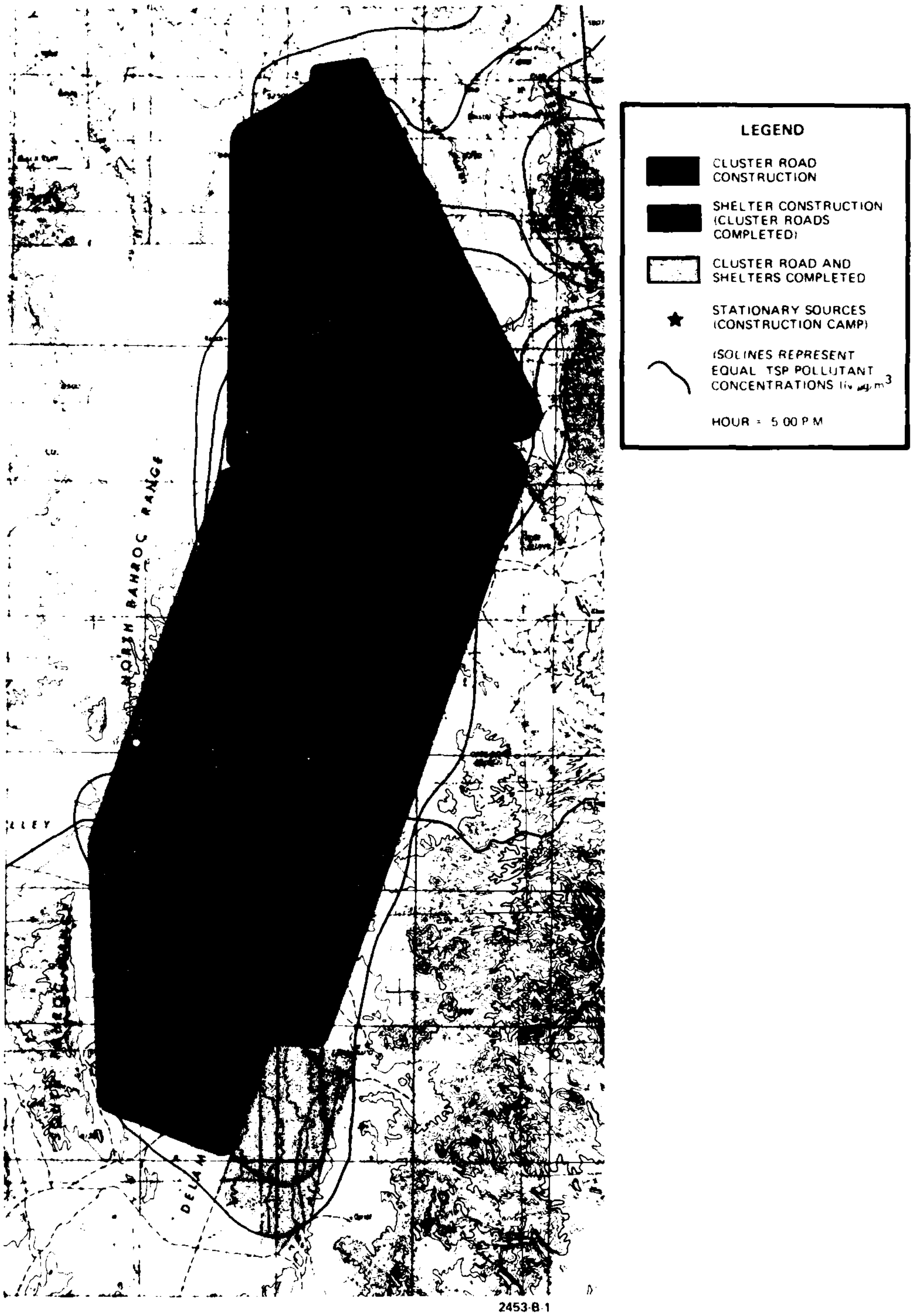


Figure 5.1.5-12. Predicted hourly particulate concentrations due to construction of shelters and cluster roads, Dry Lake/Delamar valleys.

Figure 5.1.5-13. Predicted hourly particulate concentrations due to construction of shelters and cluster roads in the Duckwater area.

Figure 5.1.5-14. Predicted hourly particulate concentrations due to construction of shelters and cluster roads in the Duckwater area.

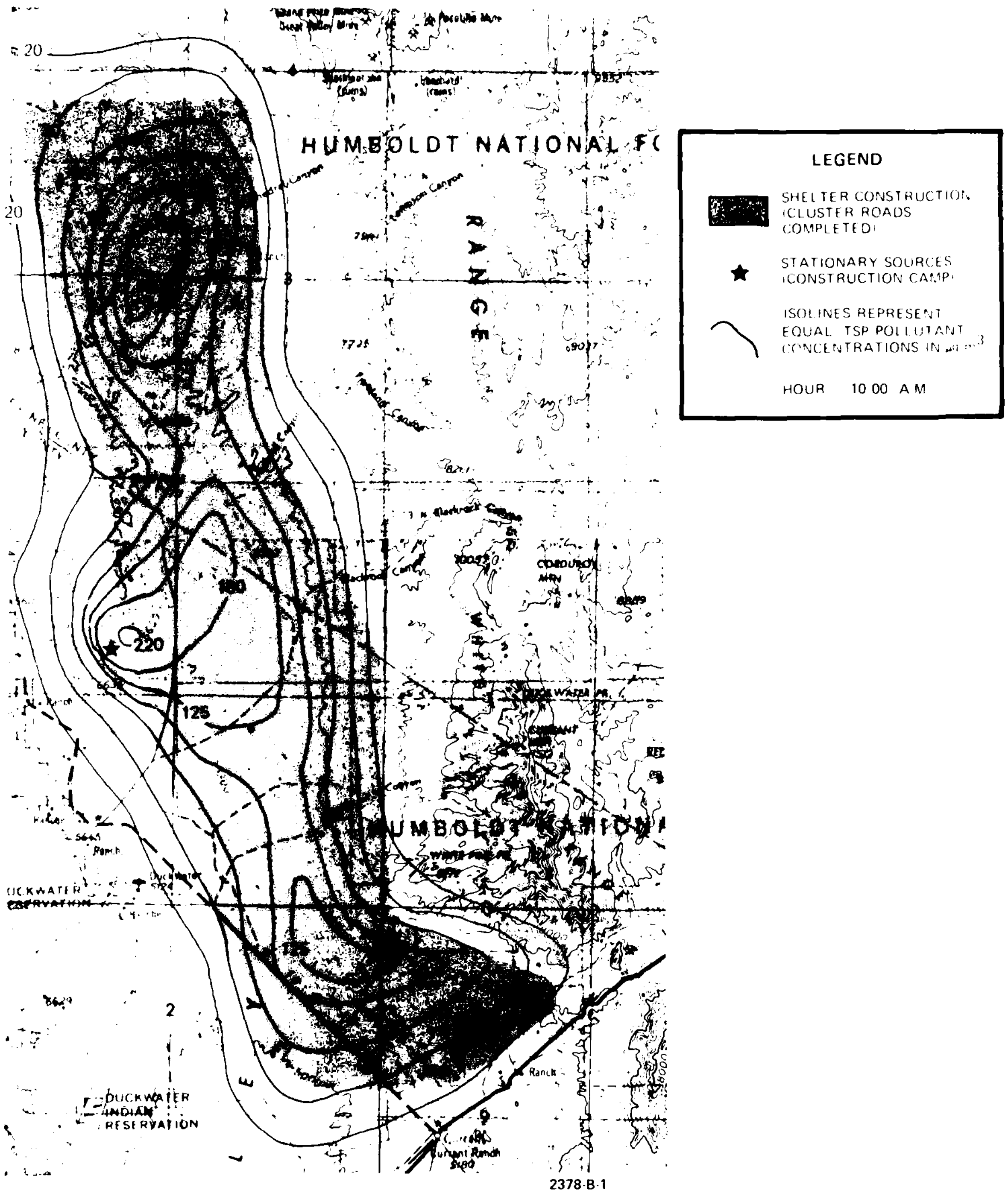


Figure 3.1.5-15. Predicted hourly particulate concentrations due to construction of shelters and cluster roads in the Duckwater area.

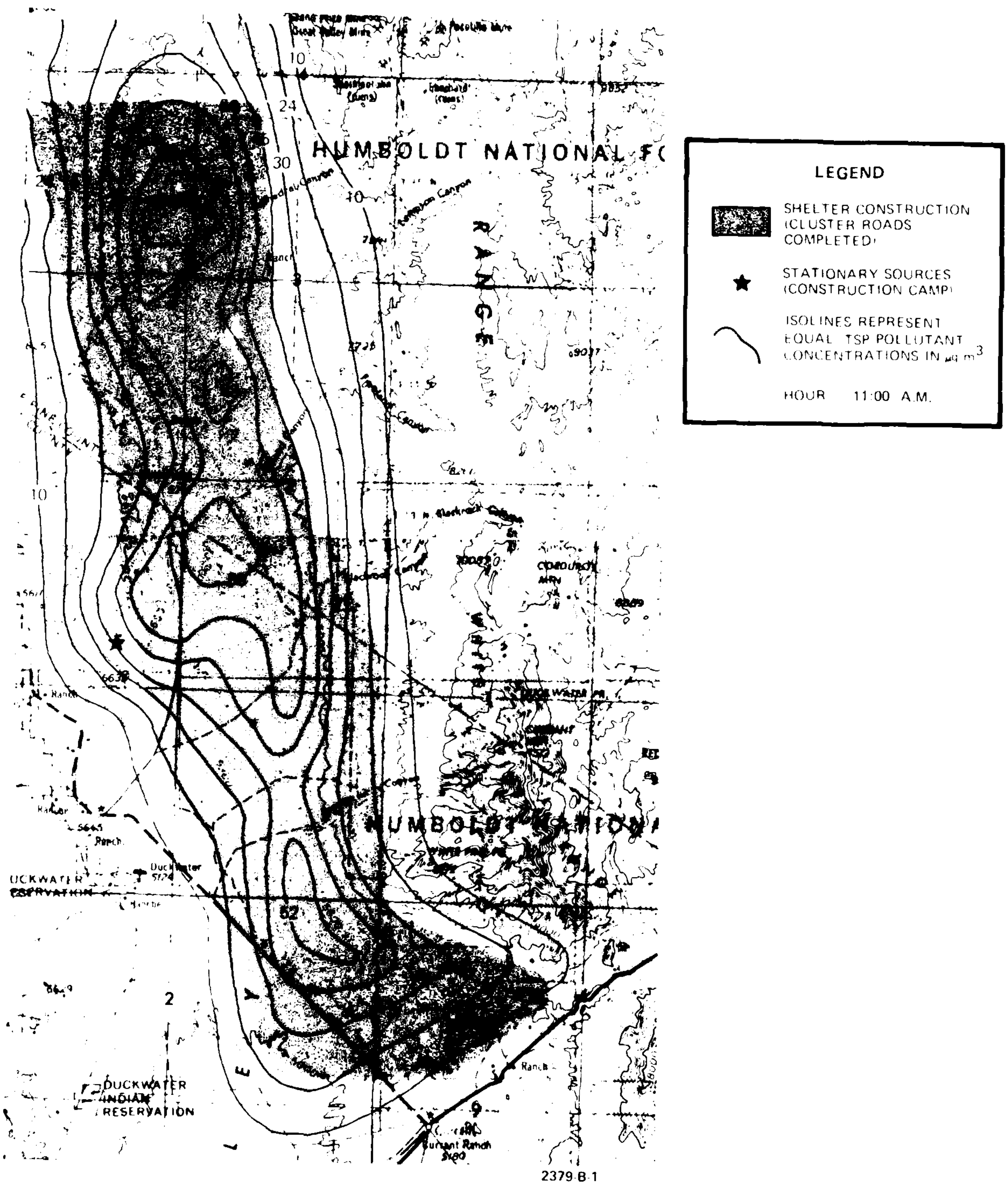


Figure 5.1.5-16. Predicted hourly particulate concentrations due to construction of shelters and cluster roads in the Duckwater area.

Figure 5.1.5-17. Predicted hourly particulate concentrations due to the construction of shelters and cluster roads in the Delta area.

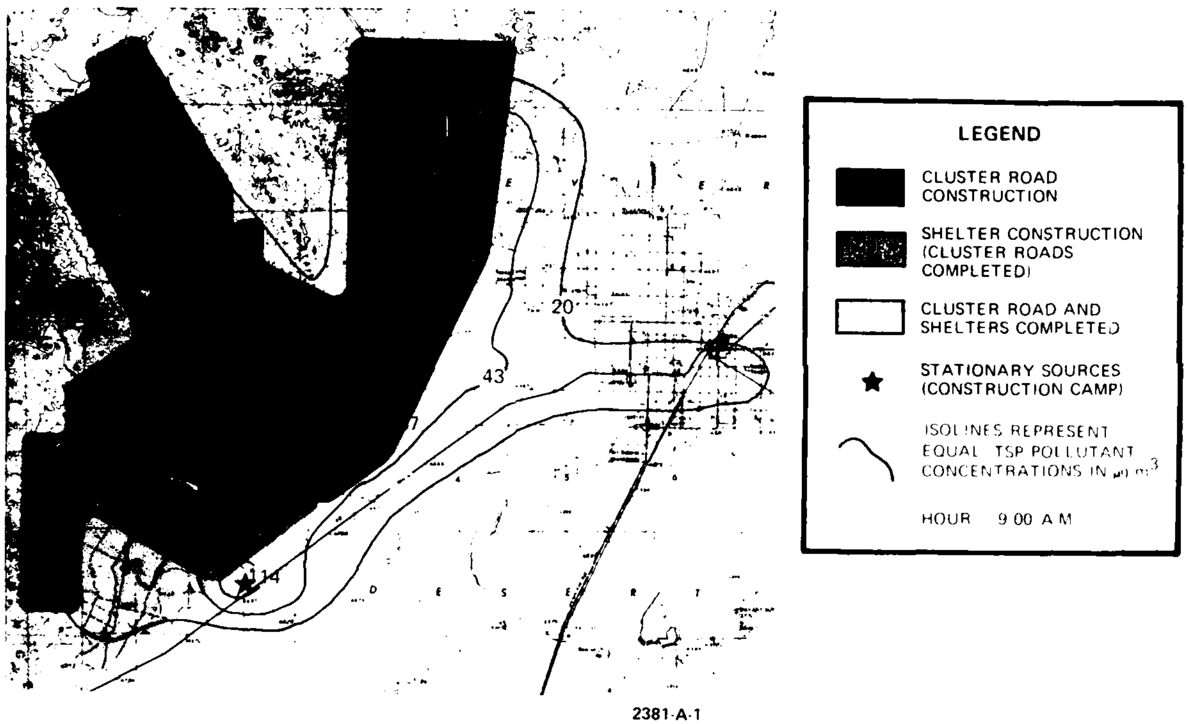


Figure 5.1.5-18. Predicted hourly particulate concentrations due to the construction of shelters and cluster roads in the Delta area.

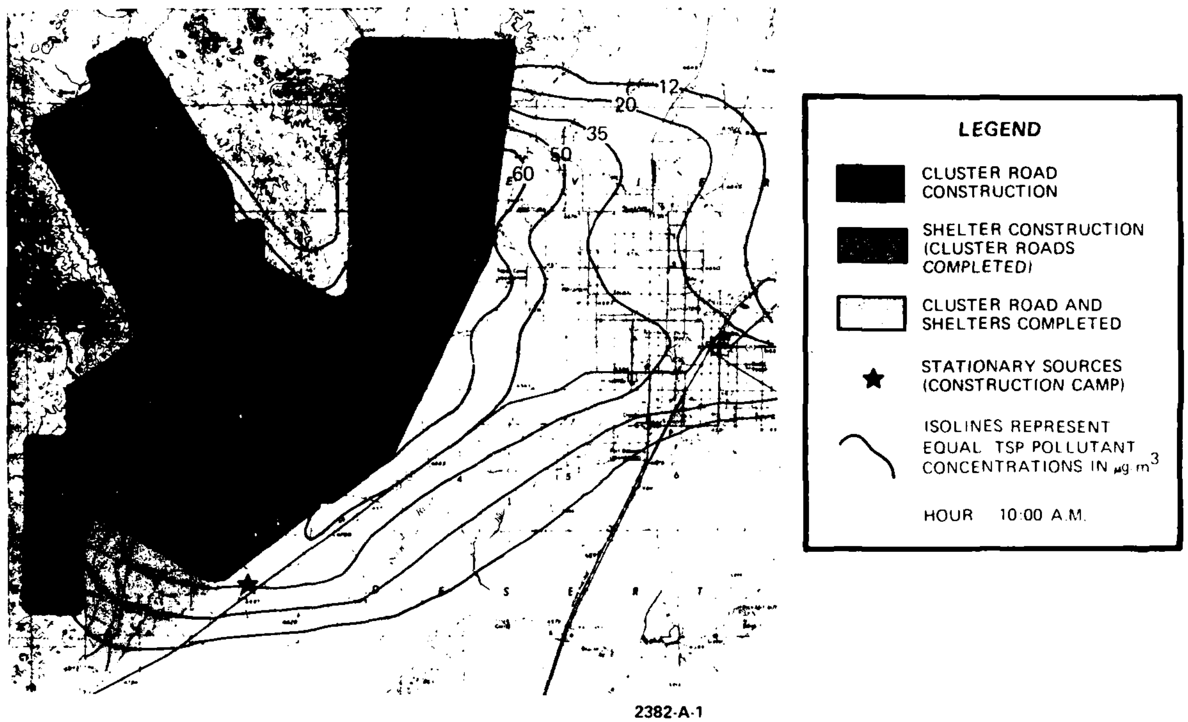


Figure 5.1.5-19. Predicted hourly particulate concentrations due to the construction of shelters and cluster roads in the Delta area.

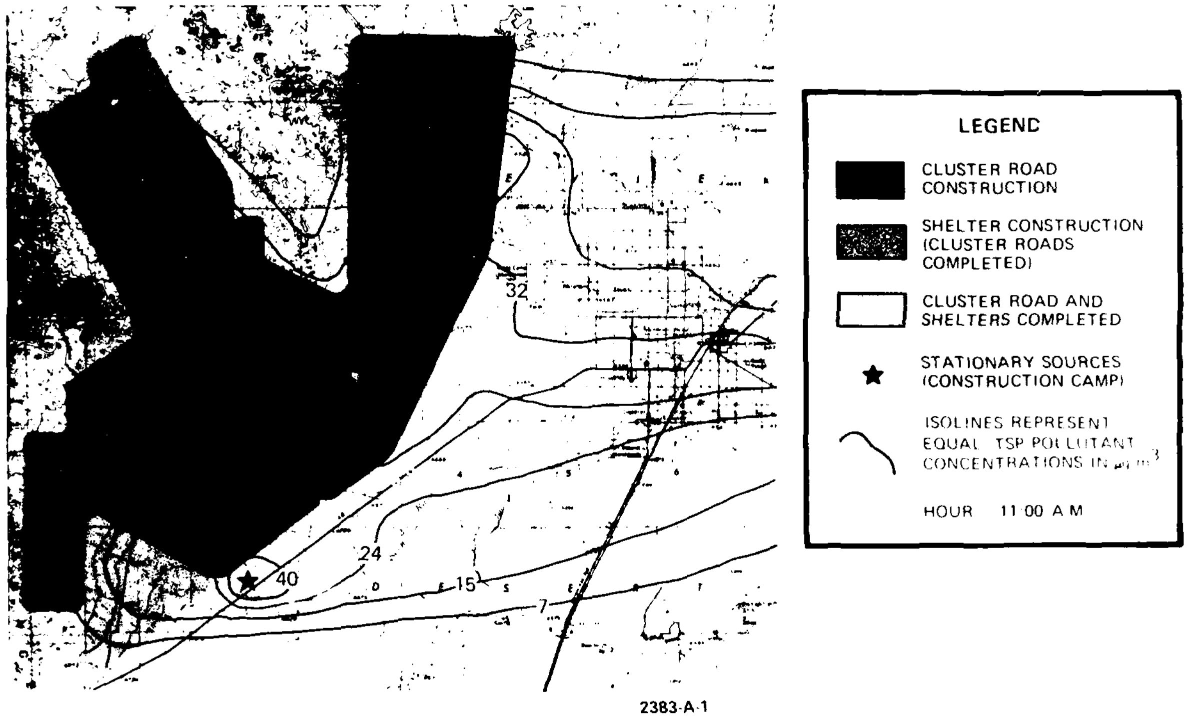


Figure 5.1.5-20. Predicted hourly particulate concentrations due to the construction of shelters and cluster roads in the Delta area.

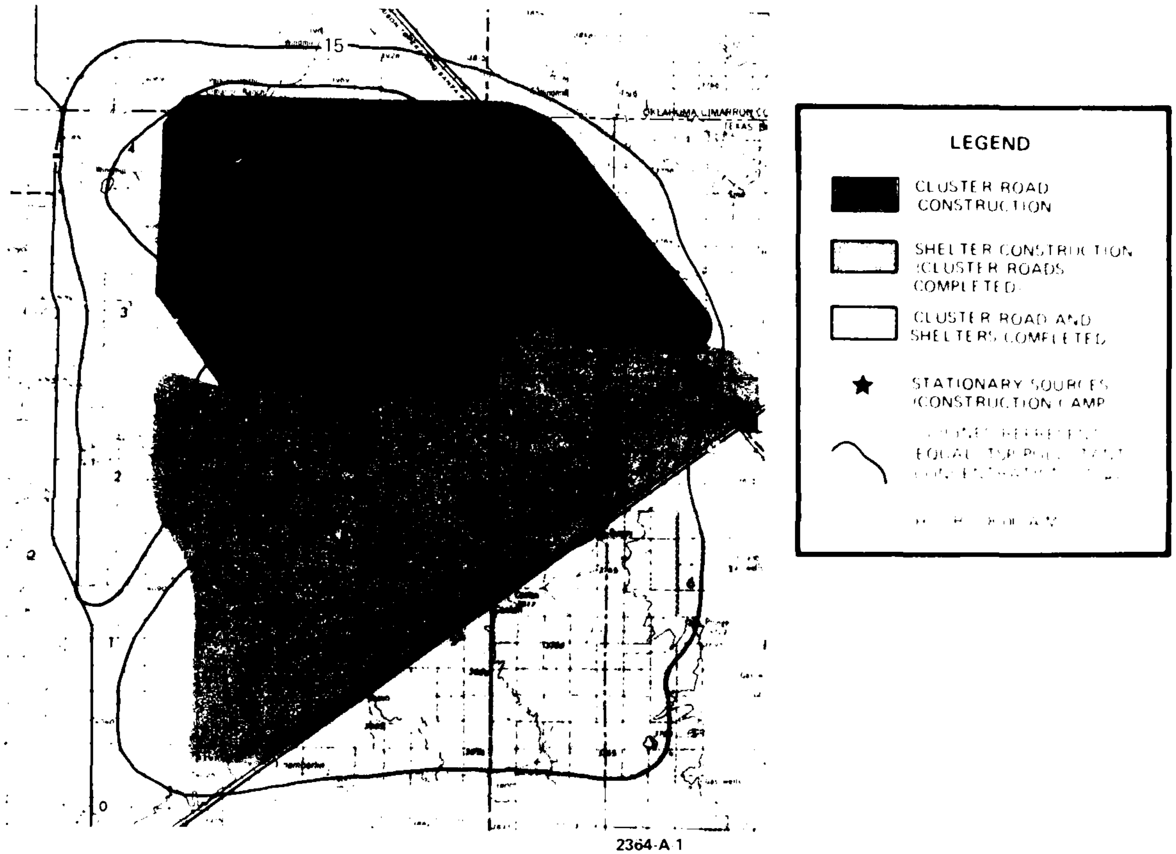


Figure 5.1.5-21. Predicted hourly particulate concentrations due to the construction of shelters and cluster roads in Dalhart area.

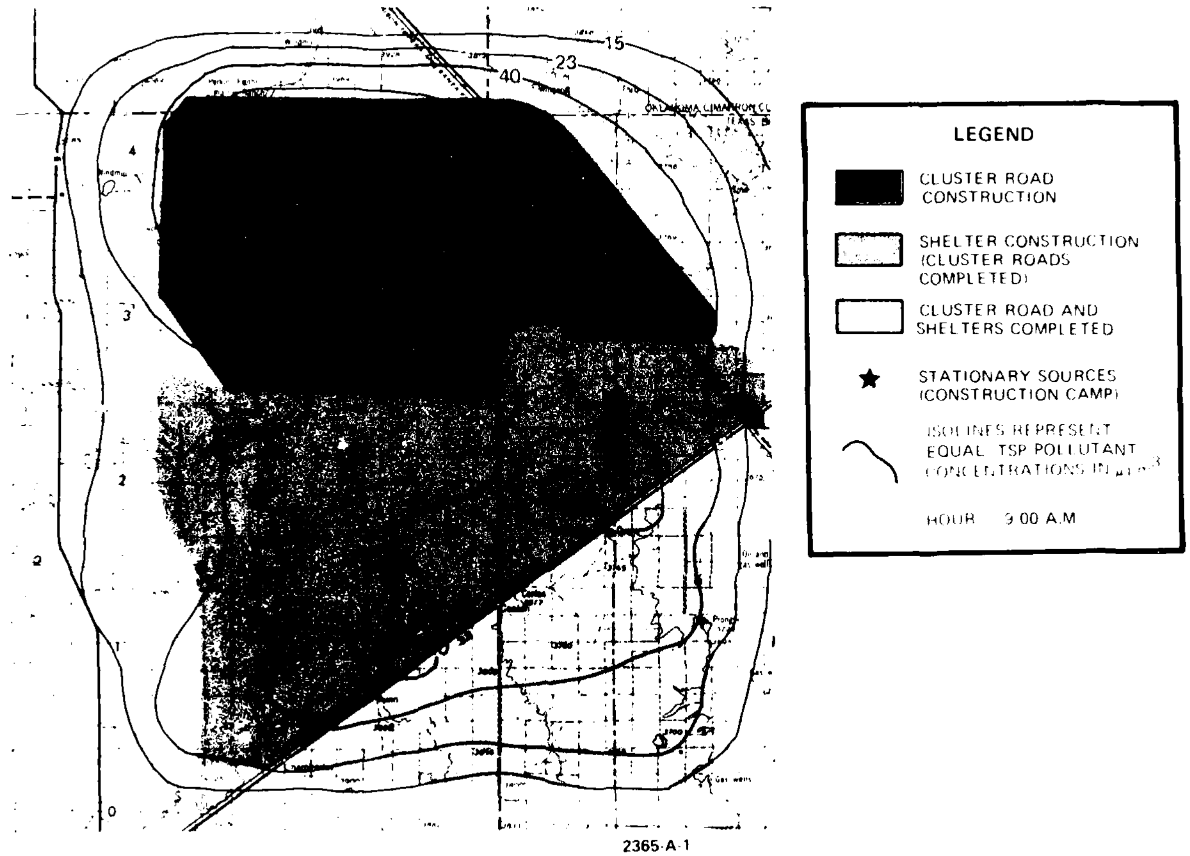


Figure 5.1.5-22. Predicted hourly particulate concentrations due to the construction of shelters and cluster roads in Dalhart area.

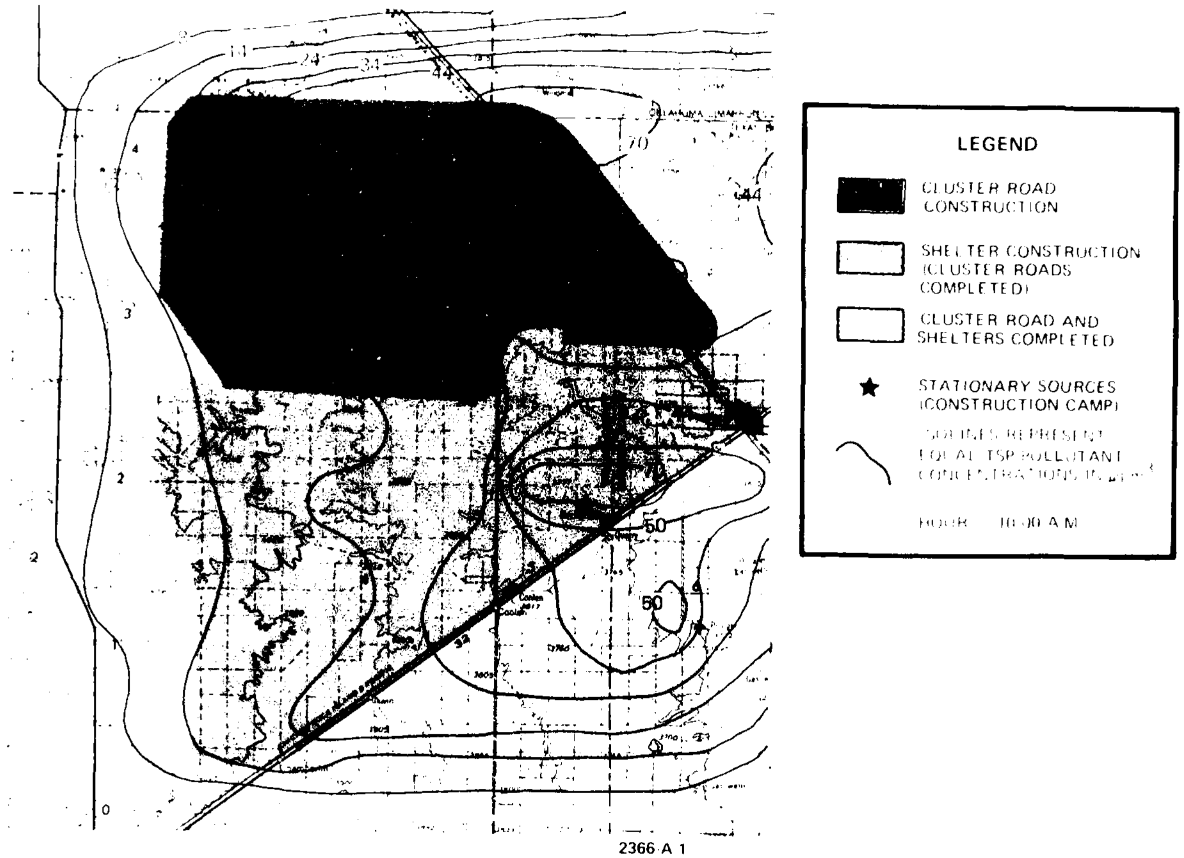


Figure 5.1.5-23. Predicted hourly particulate concentrations due to the construction of shelters and cluster roads in Dalhart area.

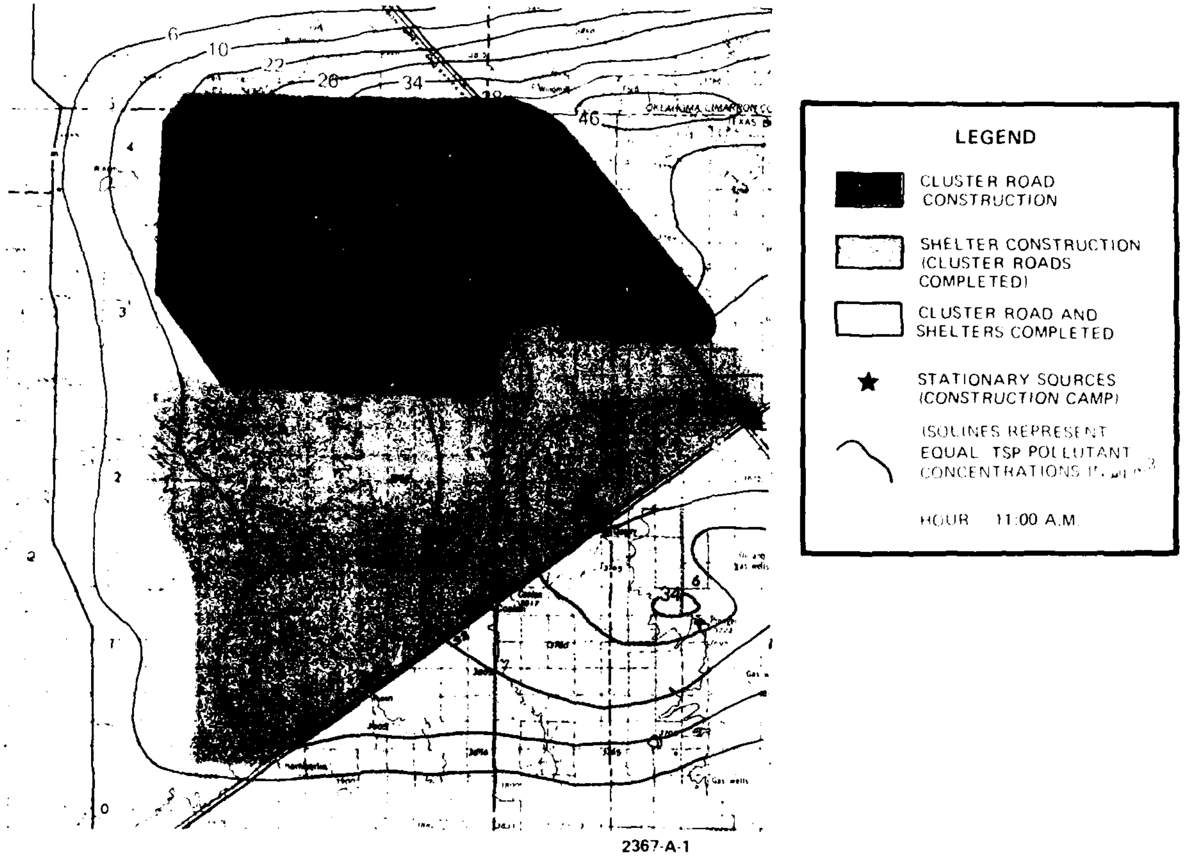


Figure 5.1.5-24. Predicted hourly particulate concentrations due to the construction of shelters and cluster roads in Dalhart area.

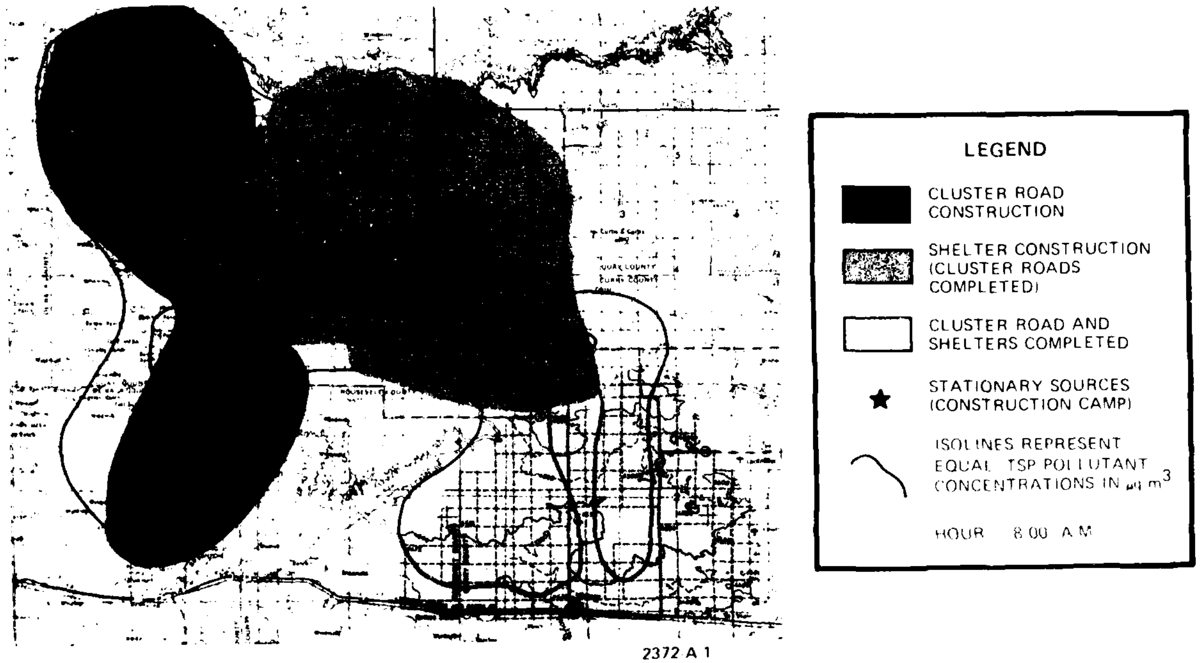


Figure 5.1.5-25. Predicted hourly particulate concentrations due to the construction of shelters and cluster roads in the Clovis area.

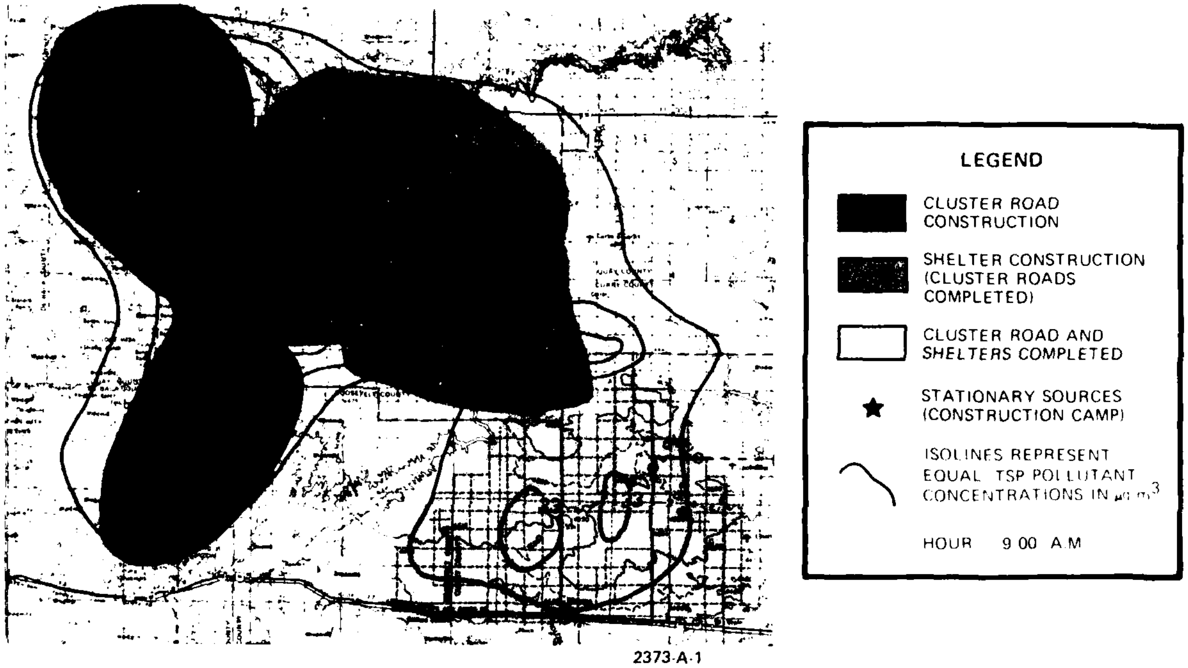


Figure 5.1.5-26. Predicted hourly particulate concentrations due to the construction of shelters and cluster roads in the Clovis area.

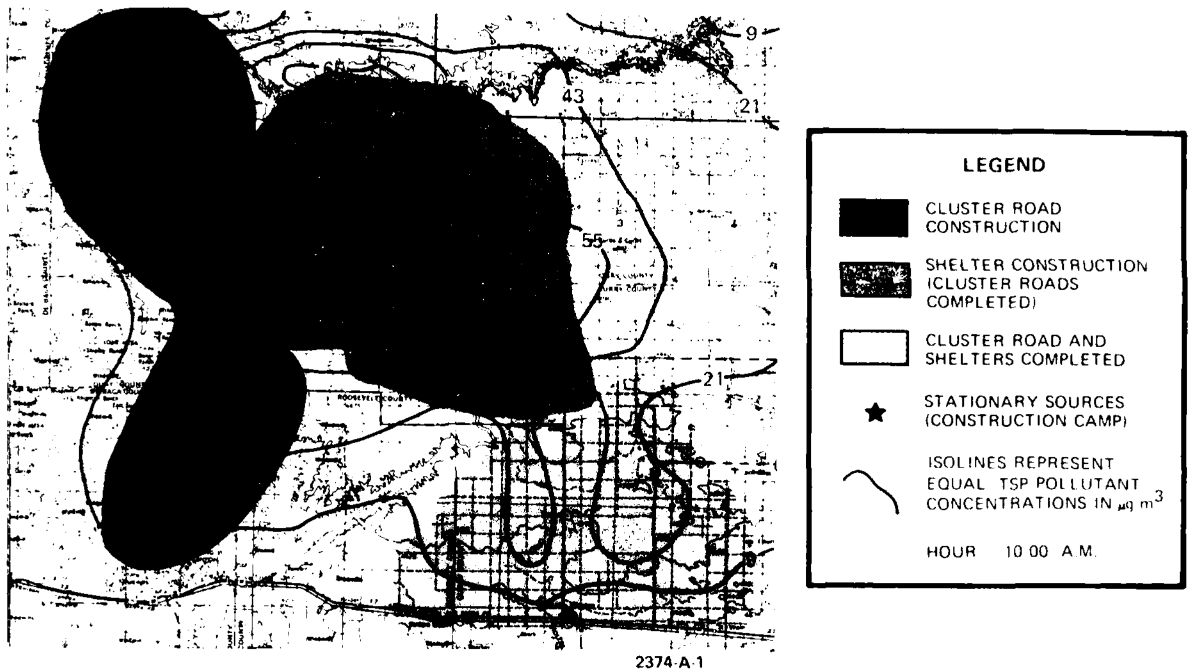


Figure 5.1.5-27. Predicted hourly particulate concentrations due to the construction of shelters and cluster roads in the Clovis area.

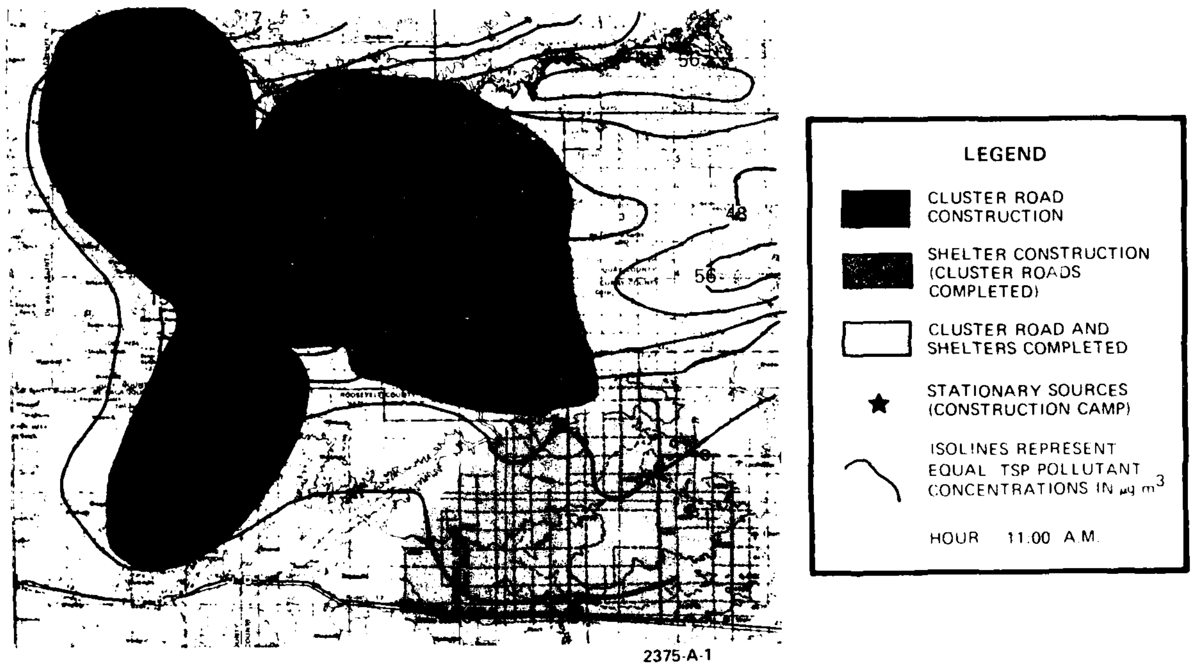


Figure 5.1.5-28. Predicted hourly particulate concentrations due to the construction of shelters and cluster roads in the Clovis area.

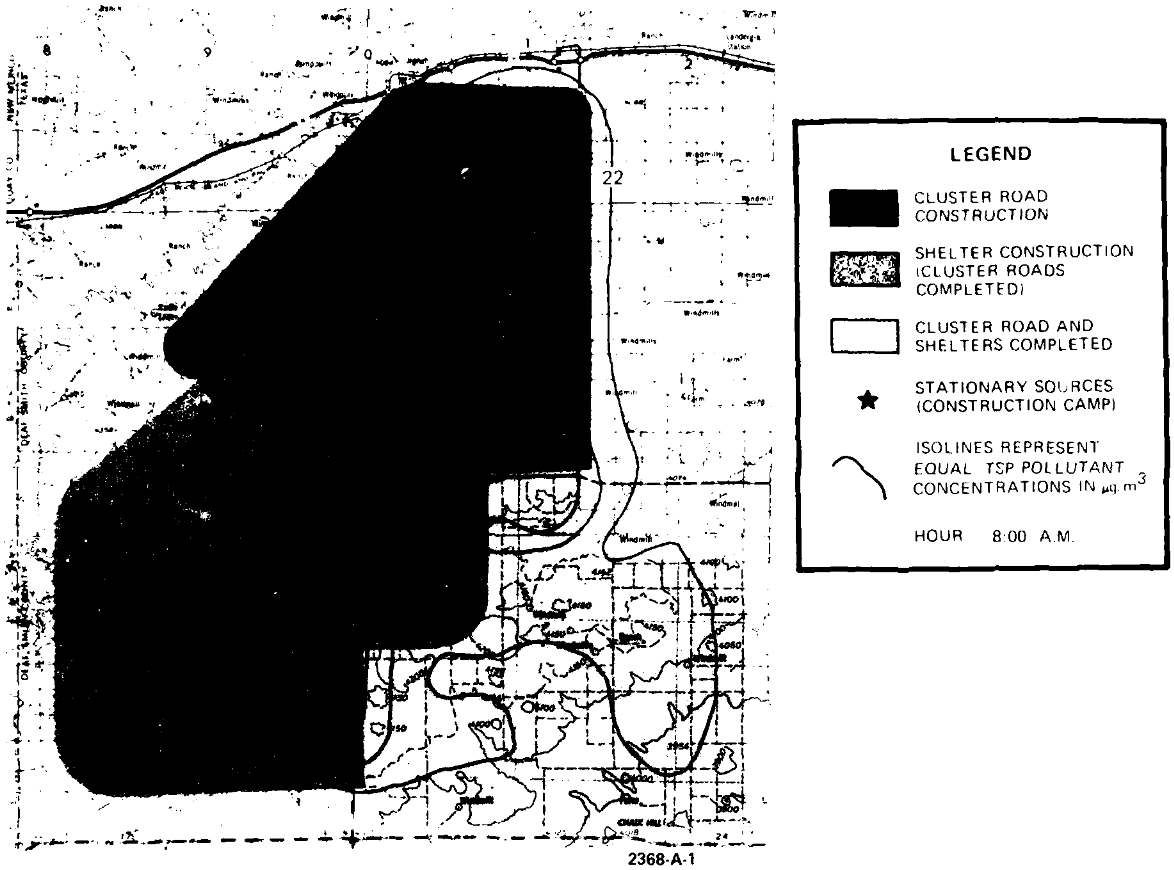


Figure 5.1.5-29. Predicted hourly particulate concentrations due to the construction of shelters and cluster roads in Hereford area.

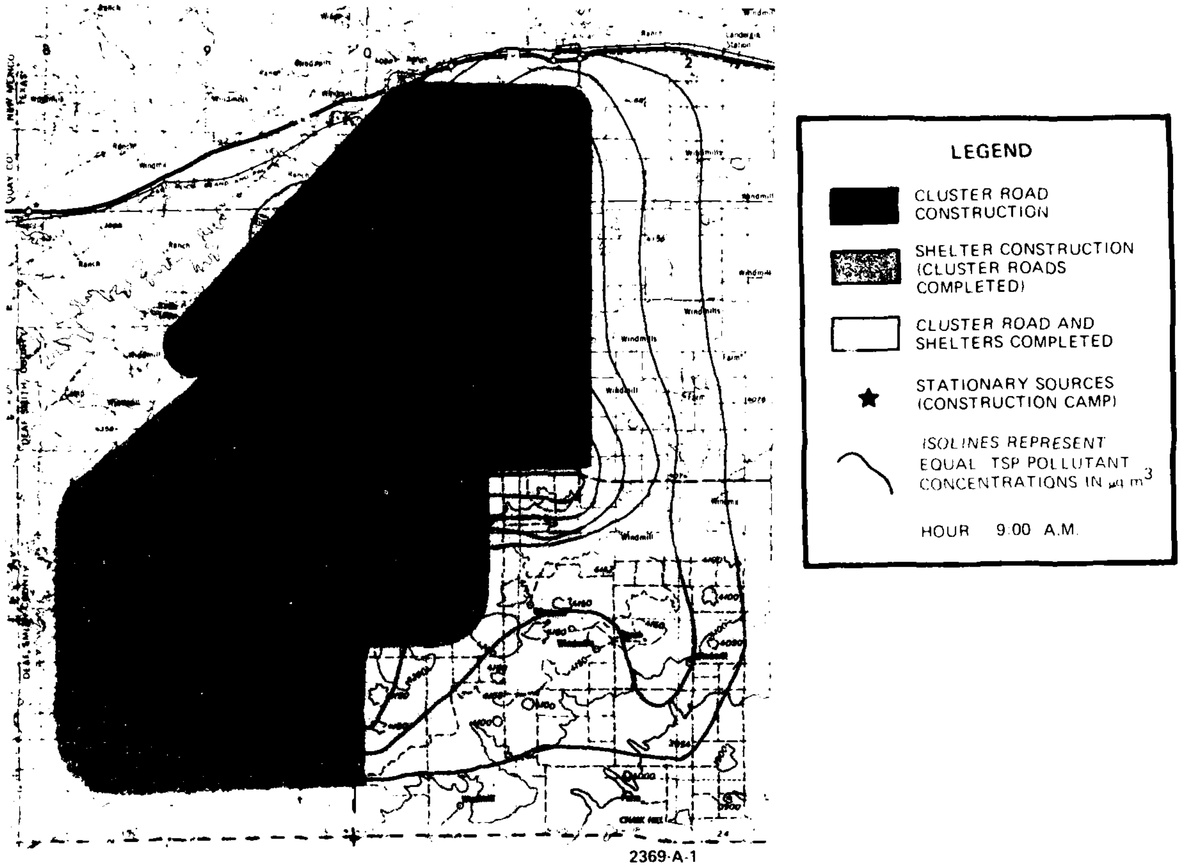


Figure 5.1.5-30. Predicted hourly particulate concentrations due to the construction of shelters and cluster roads in Hereford area.

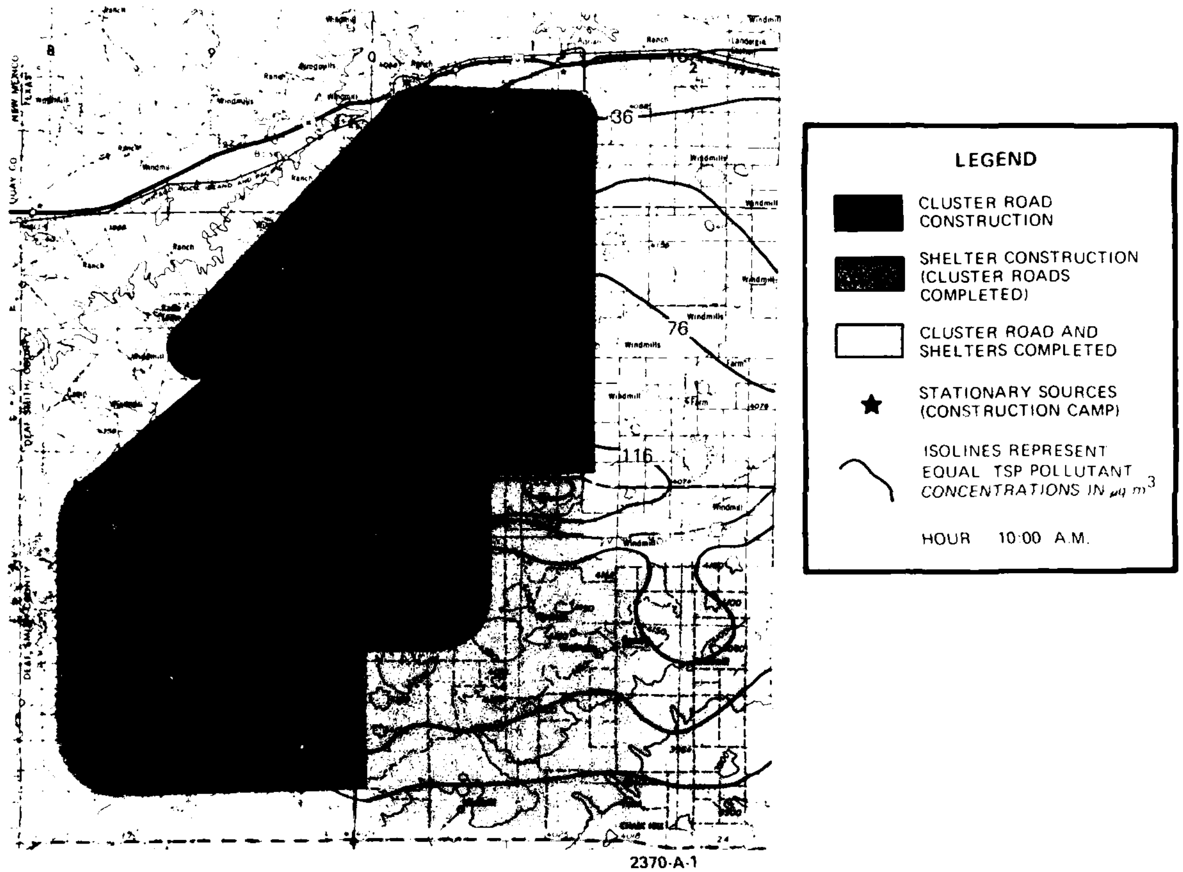


Figure 5.1.5-31. Predicted hourly particulate concentrations due to the construction of shelters and cluster roads in Hereford area.

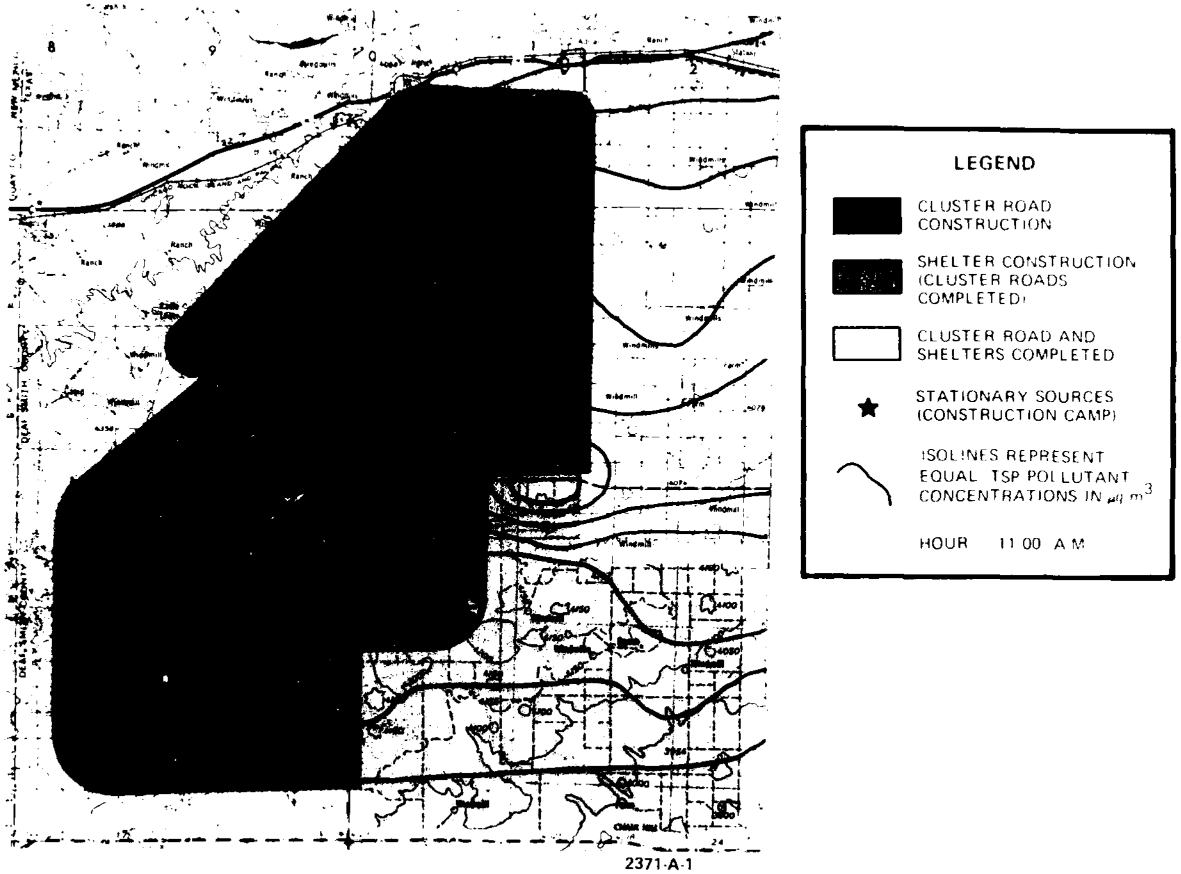


Figure 5.1.5-32. Predicted hourly particulate concentrations due to the construction of shelters and cluster roads in Hereford area.

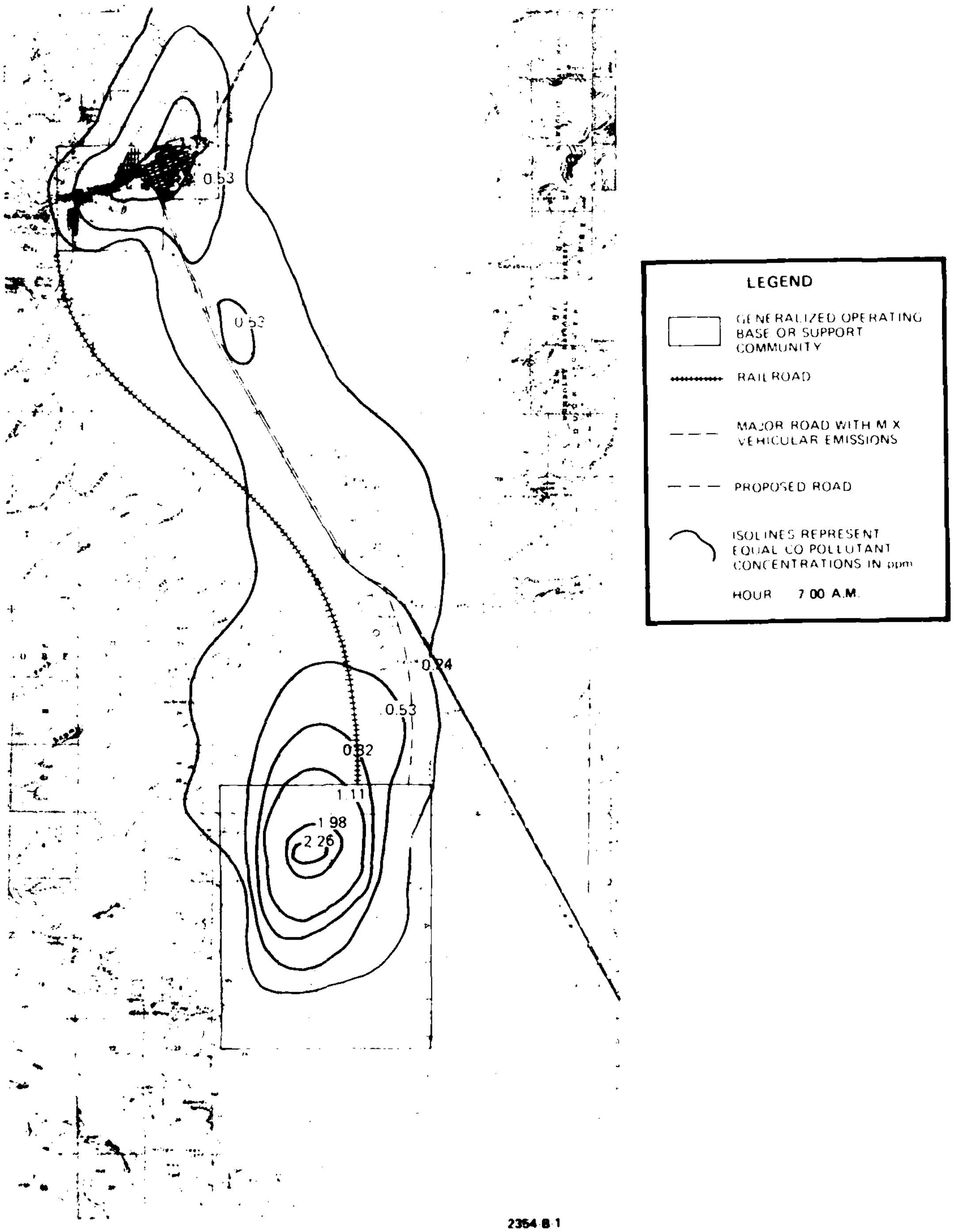


Figure 5.1.5-33. Predicted hourly CO concentrations at the Ely OB site and community.

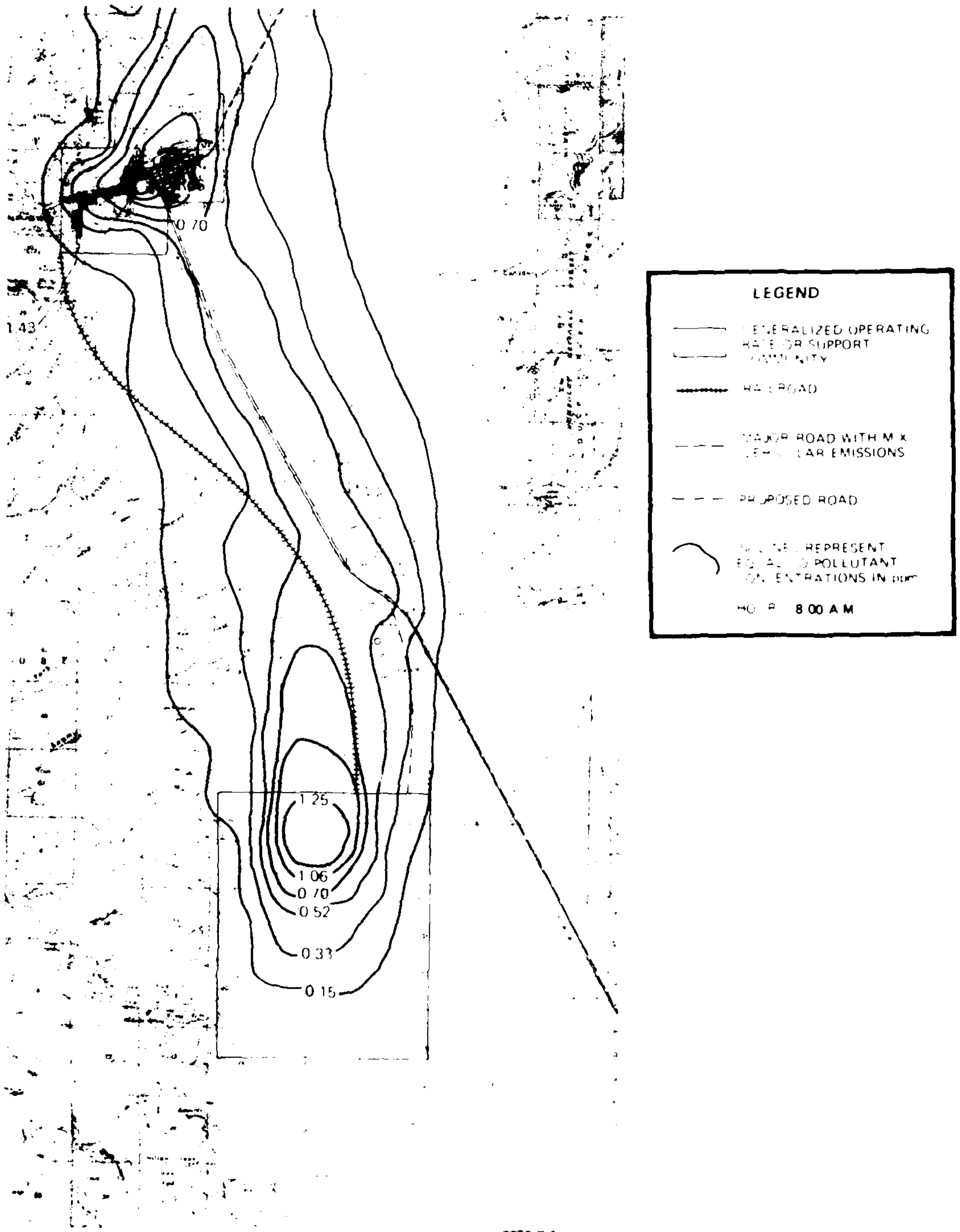


Figure 5.1.5-34. Predicted hourly CO concentrations at the Ely OB site and community.

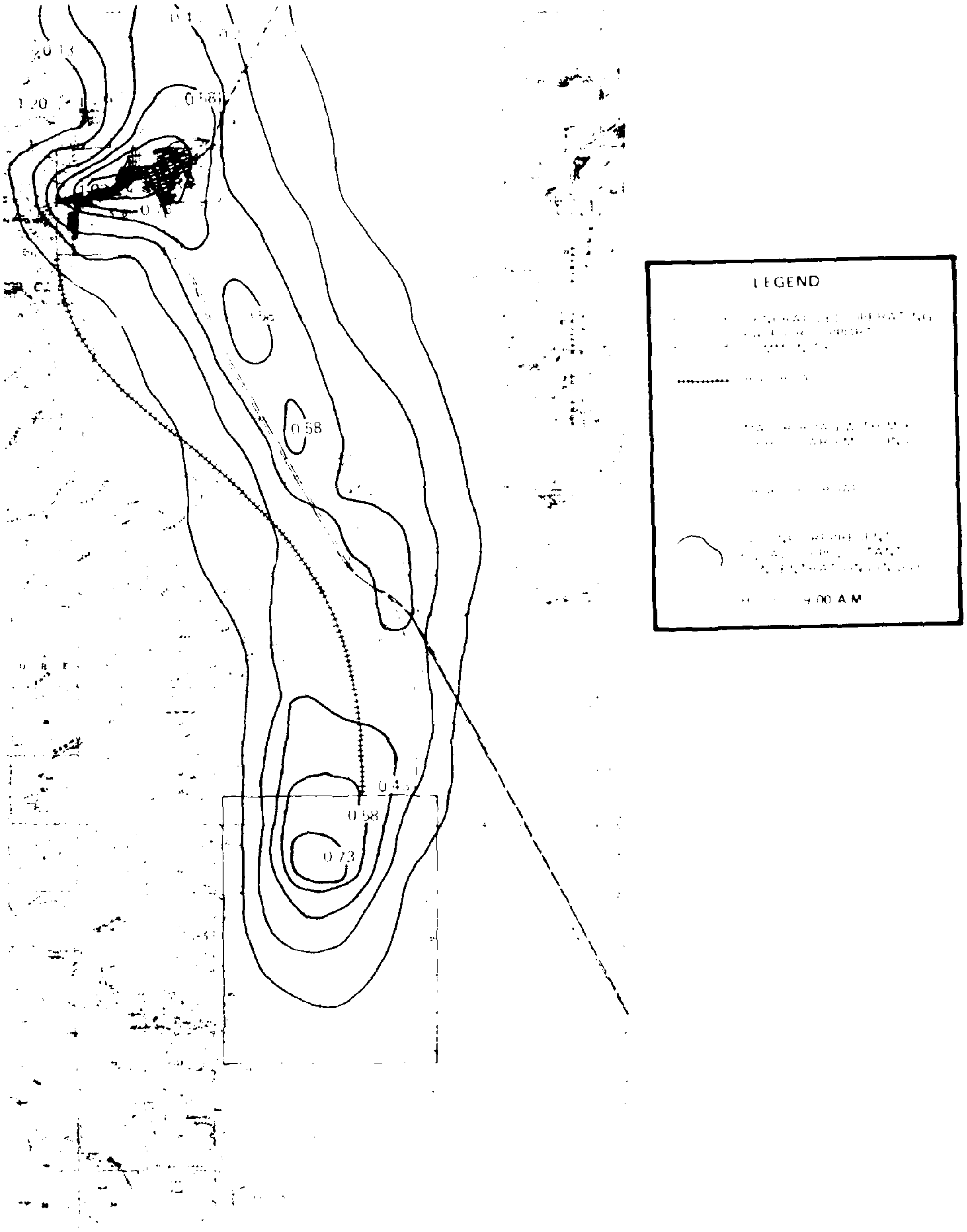


Figure 5.1.5-35. Predicted hourly CO concentrations at the Ely OB site and community.

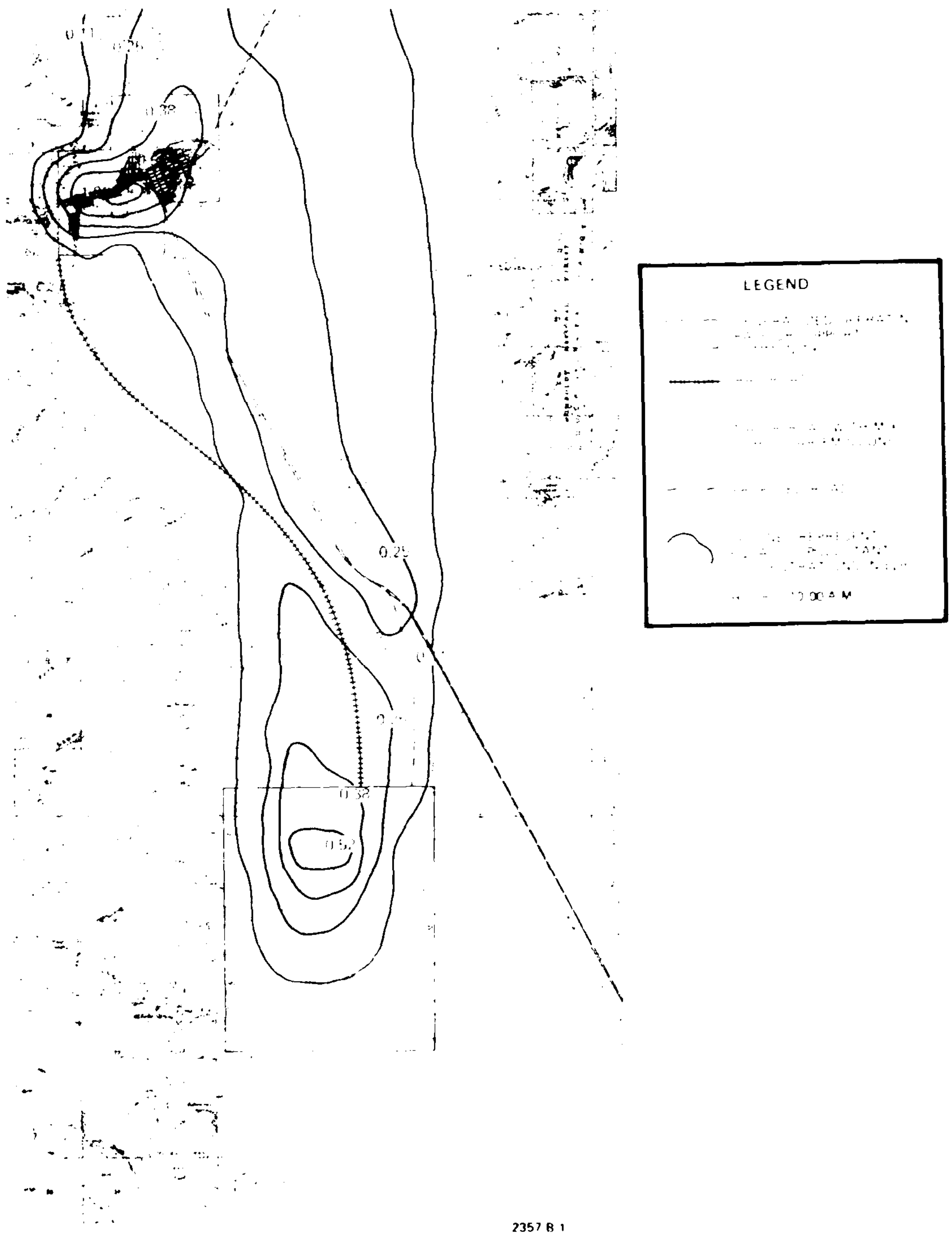


Figure 5.1.5-36. Predicted hourly CO concentrations at the Ely OB site and community.

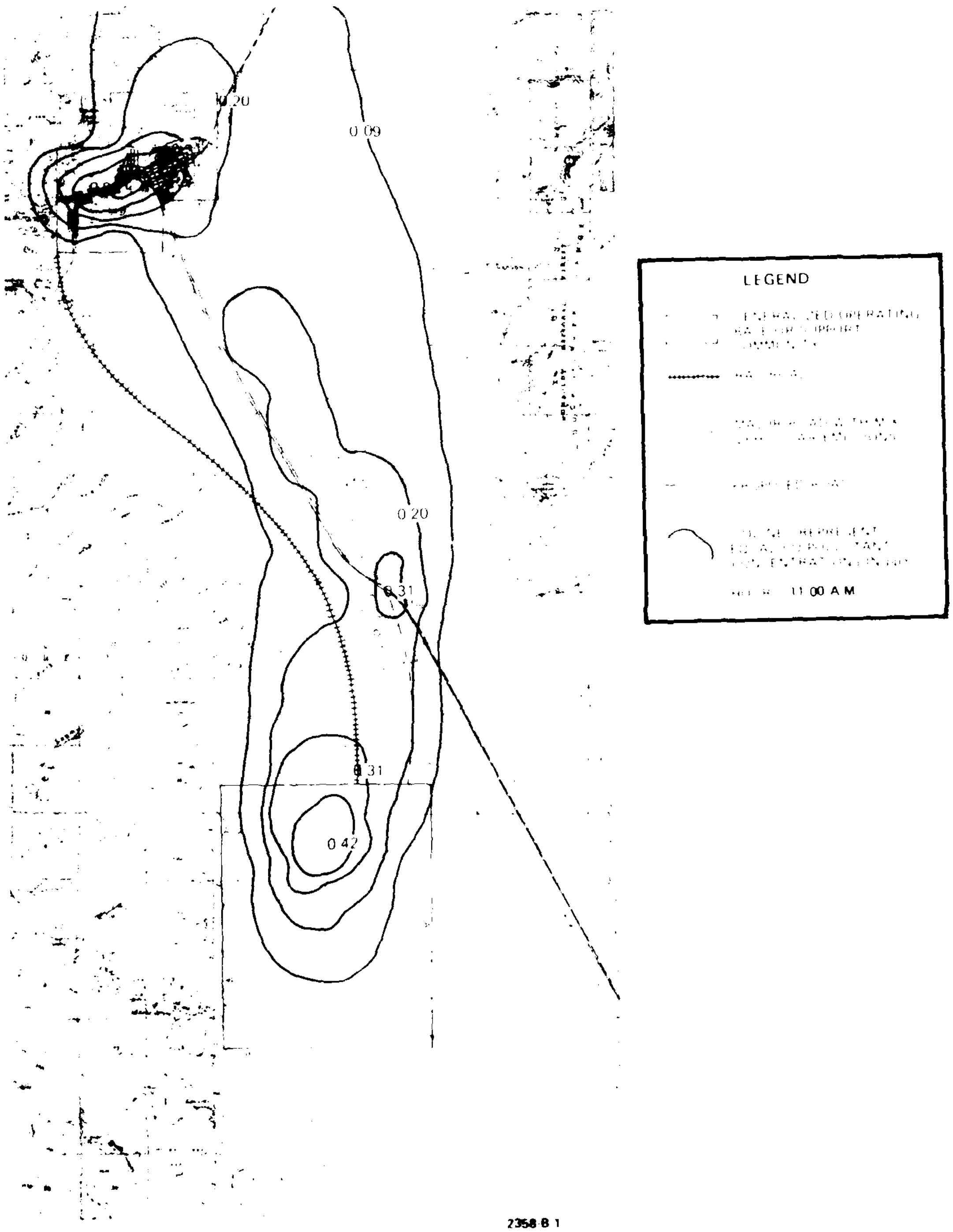


Figure 5.1.5-37. Predicted hourly CO concentrations at the Ely OB site and community.

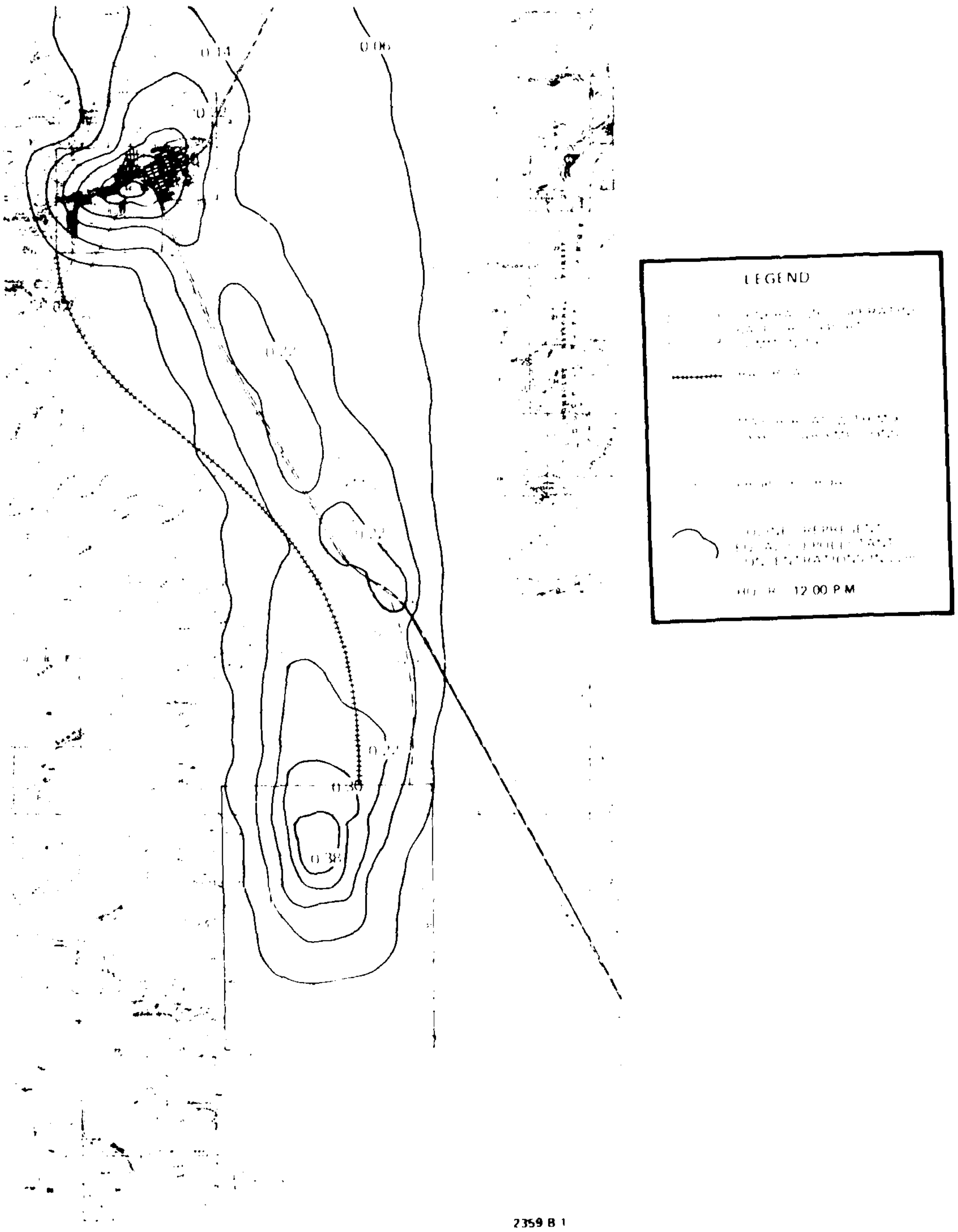
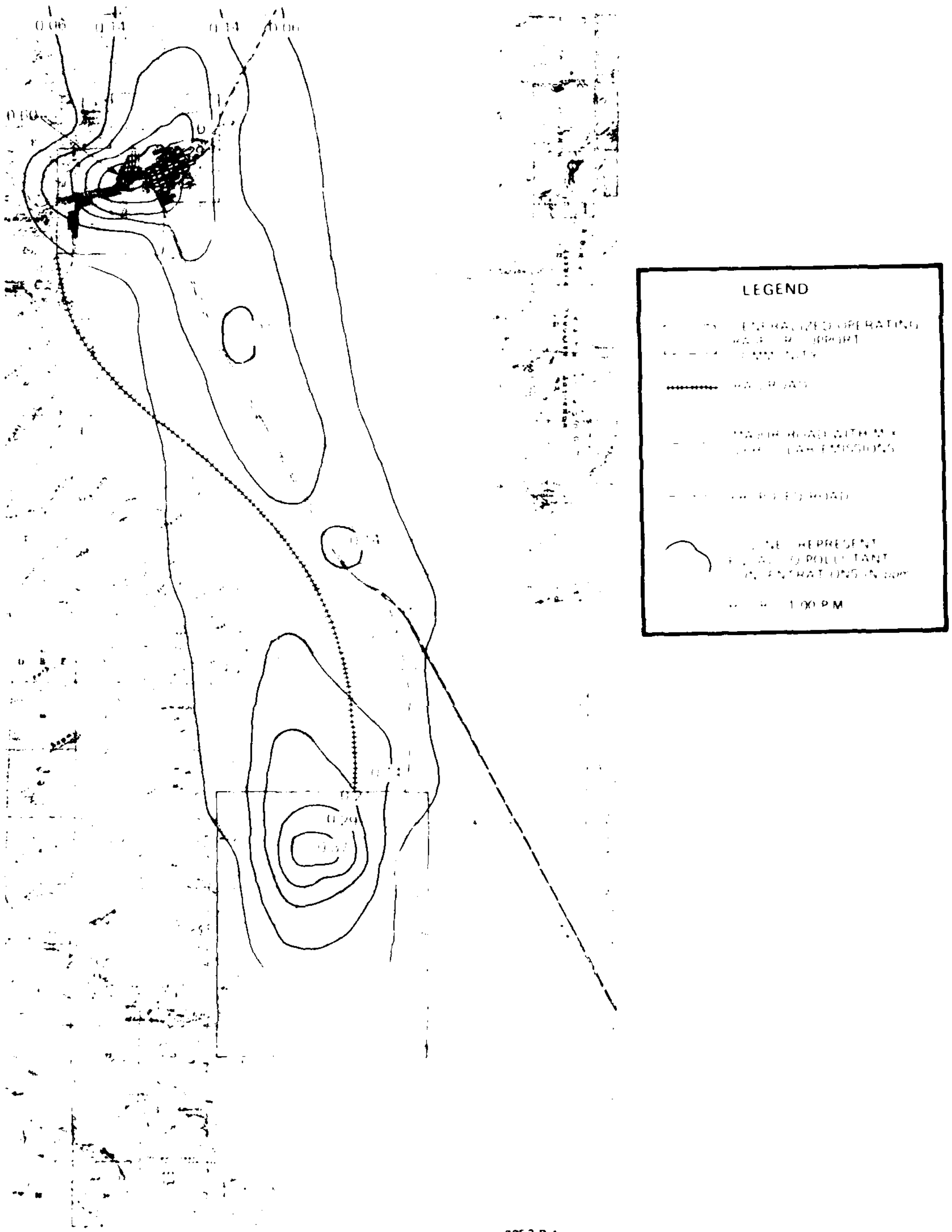


Figure 5.1.5-38. Predicted hourly CO concentrations at the Ely OB site and community.



2352 B 1

Figure 5.1.5-39. Predicted hourly CO concentrations at the Ely OB site and community.

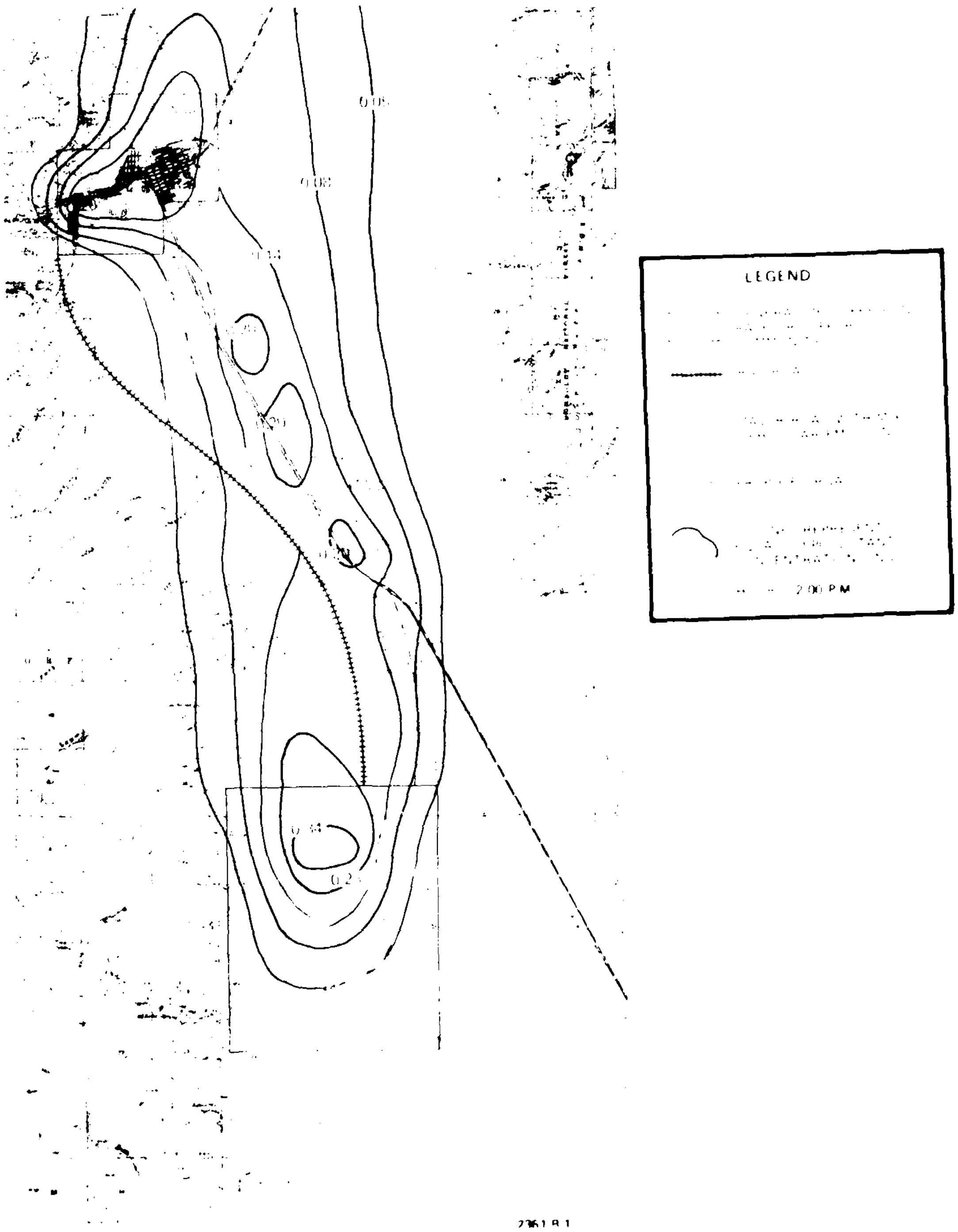
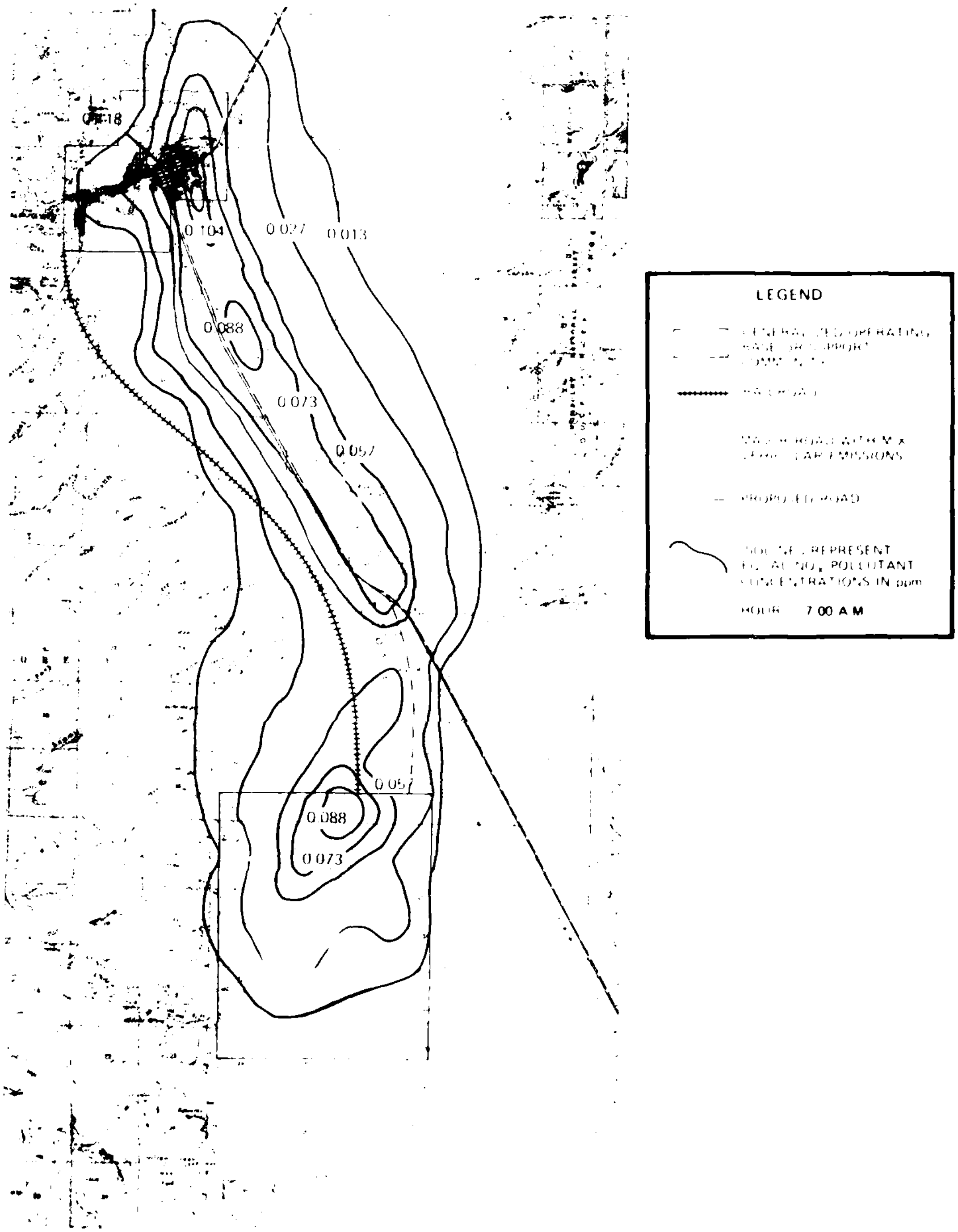


Figure 5.1.5-40. Predicted hourly CO concentrations at the Ely OB site and community.



2346 B 1

Figure 5.1.5-41. Predicted hourly NO_x concentrations at the Ely OB site and community.

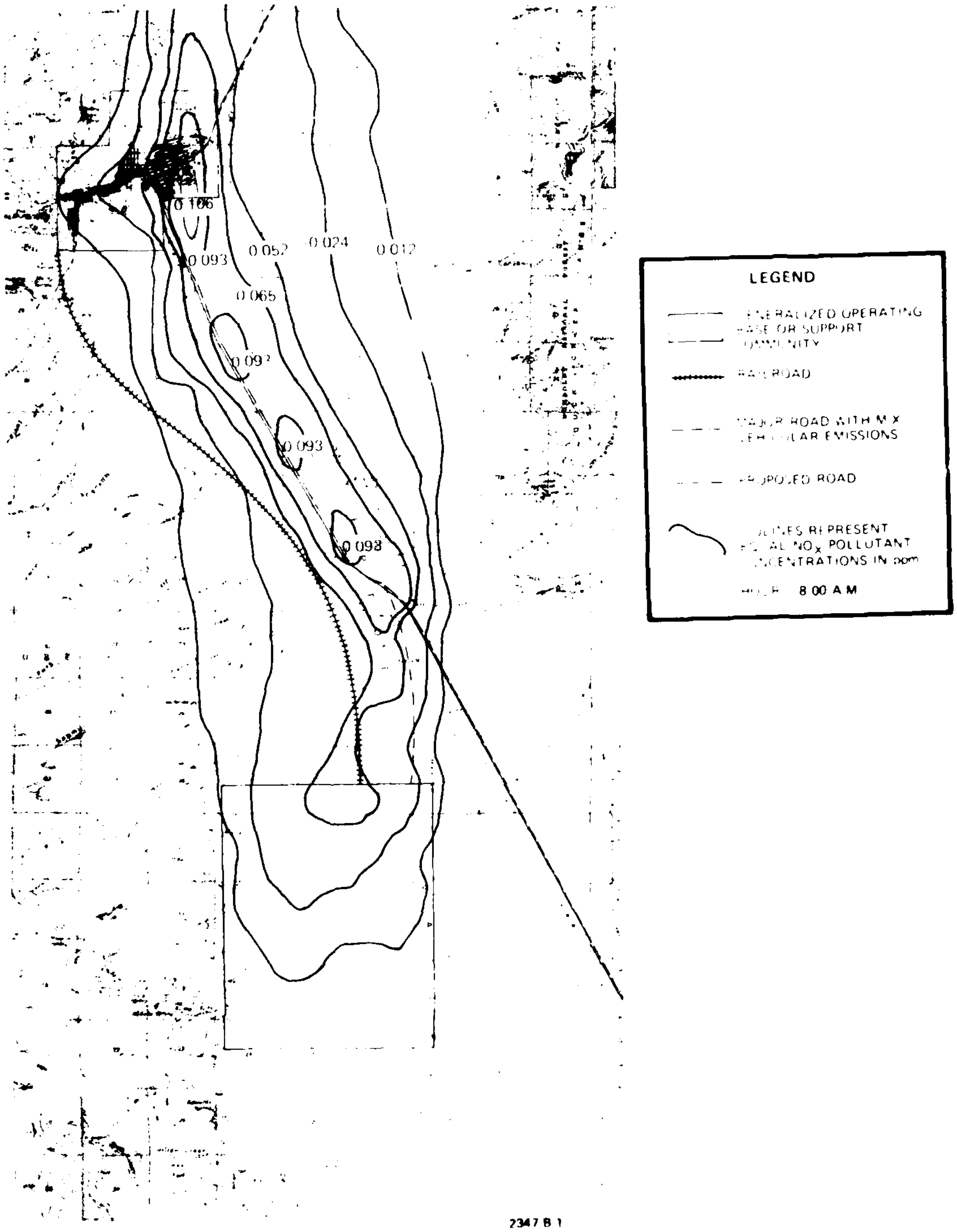


Figure 5.1.5-42. Predicted hourly NO_X concentrations at the Ely OB site and community.

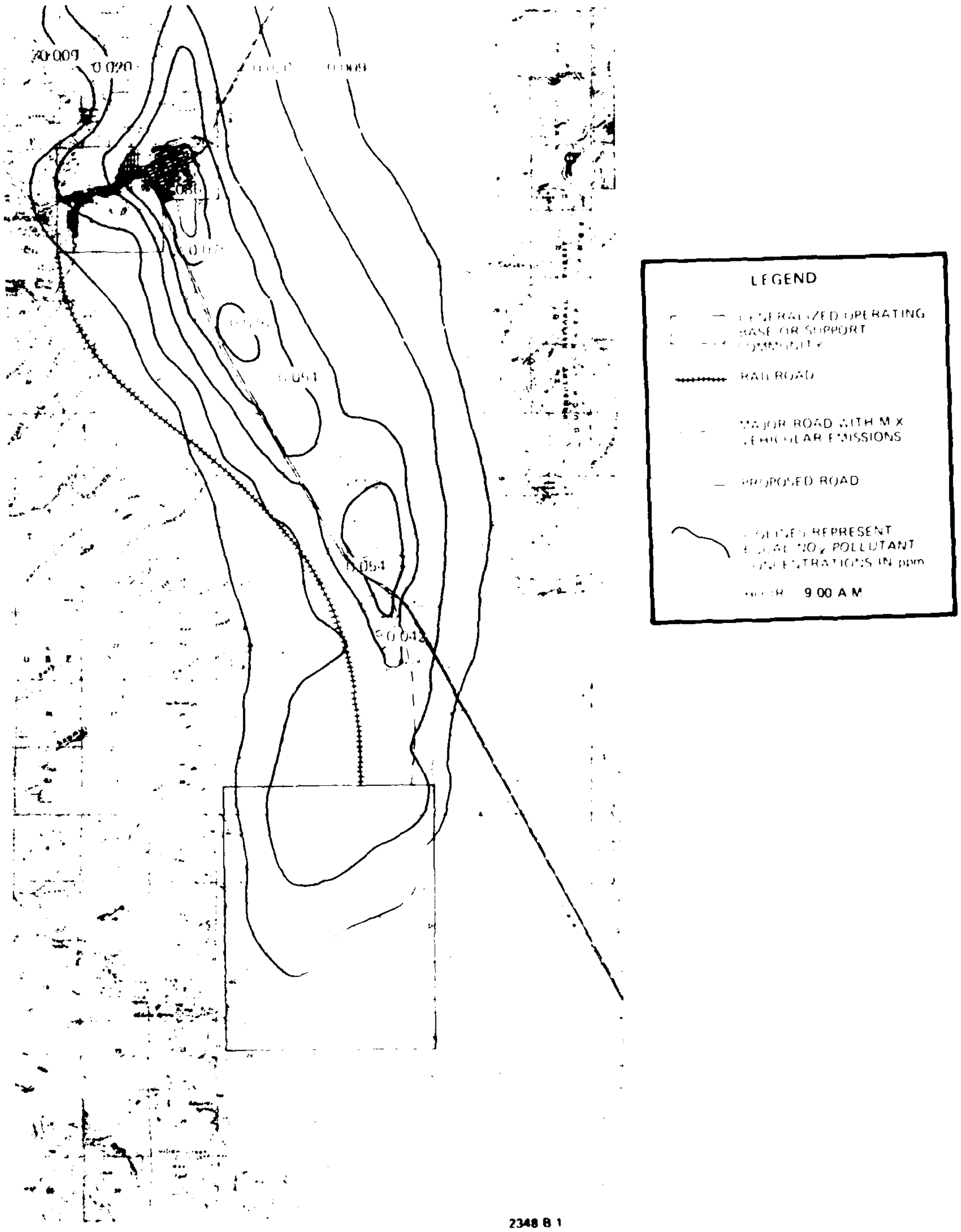


Figure 5.1.5-43. Predicted hourly NO_x concentrations at the Ely OB site and community.

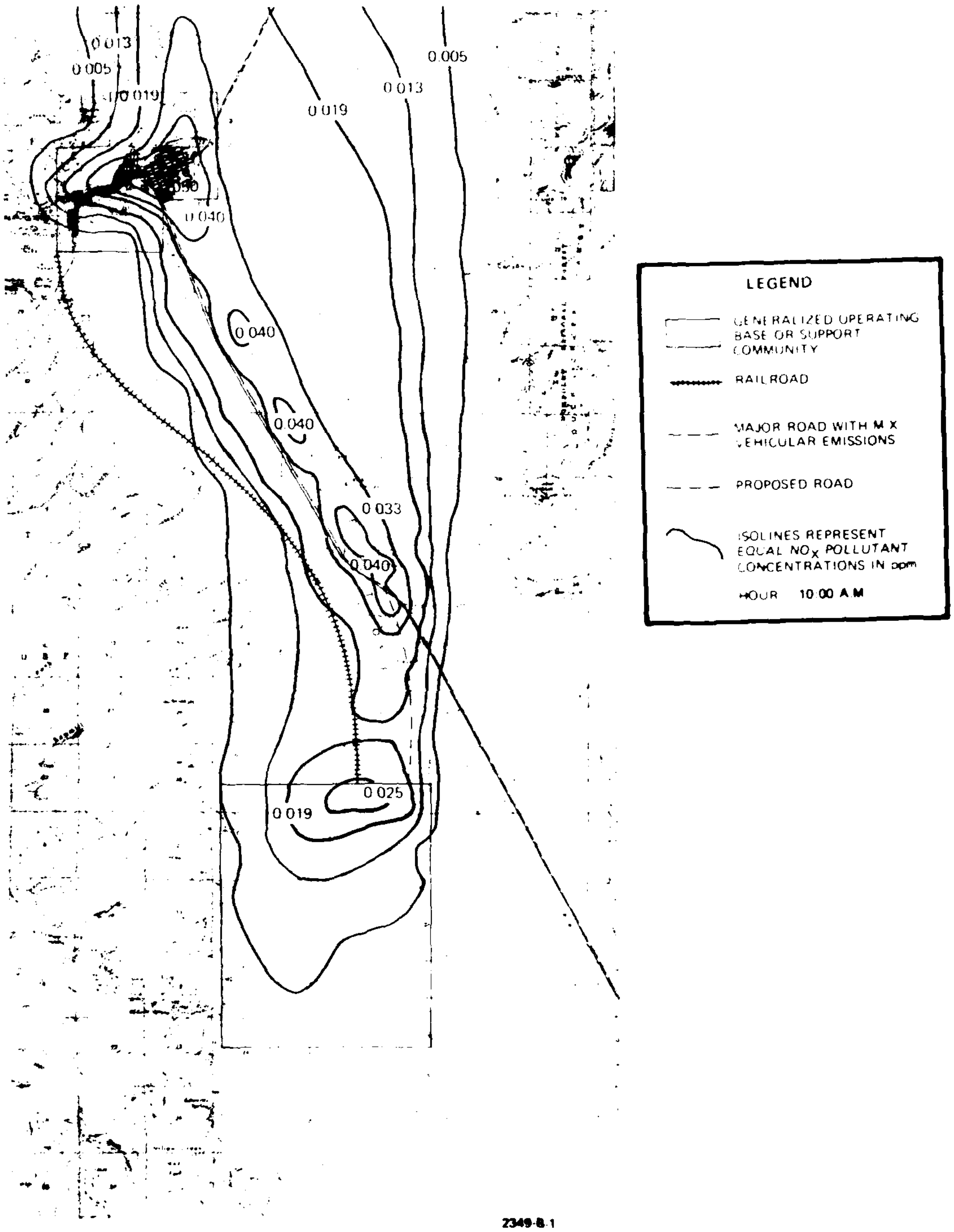


Figure 5.1.5-44. Predicted hourly NO_x concentrations at the Ely OB site and community.

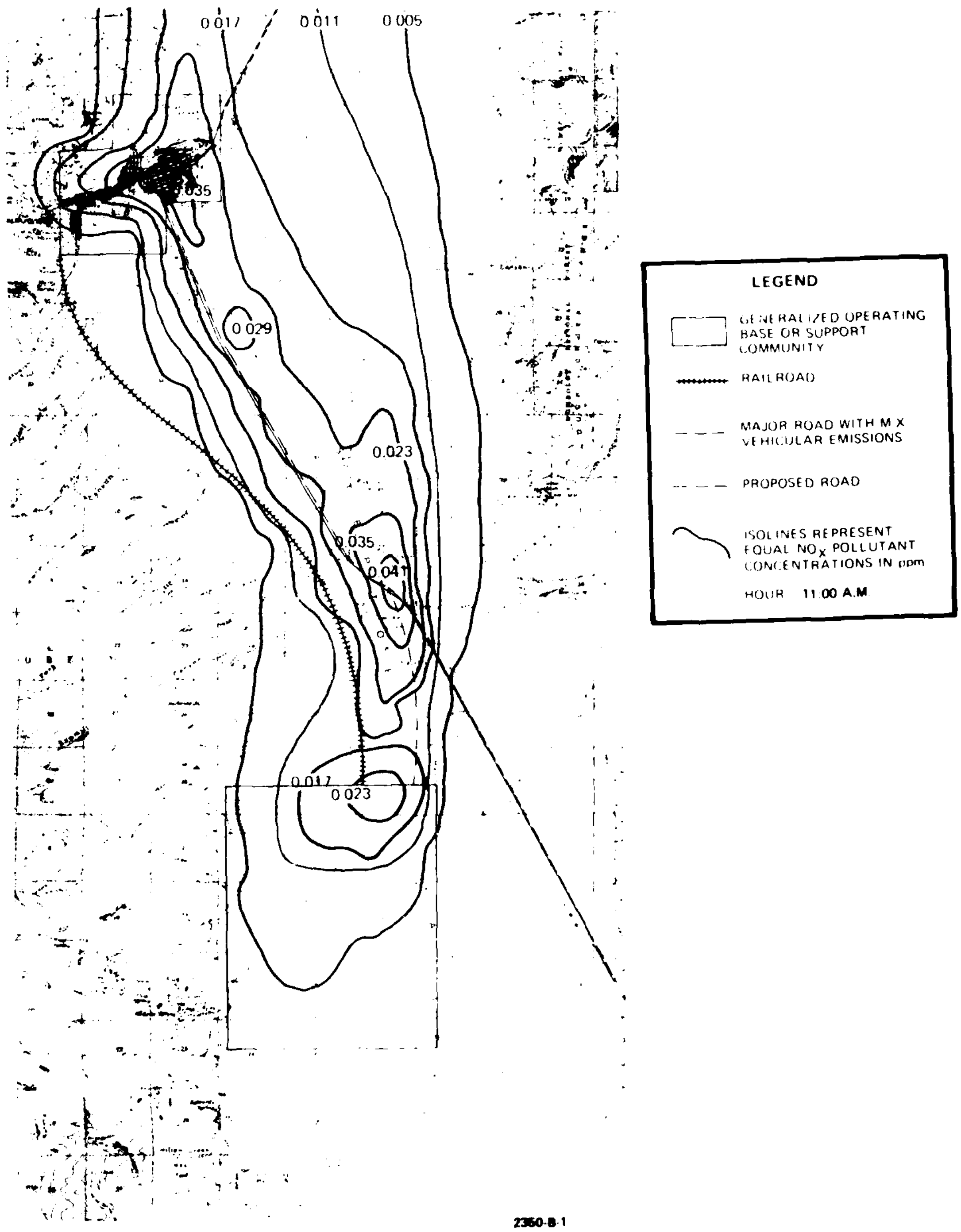


Figure 5.1.5-45. Predicted hourly NO_x concentrations at the Ely OB site and community.

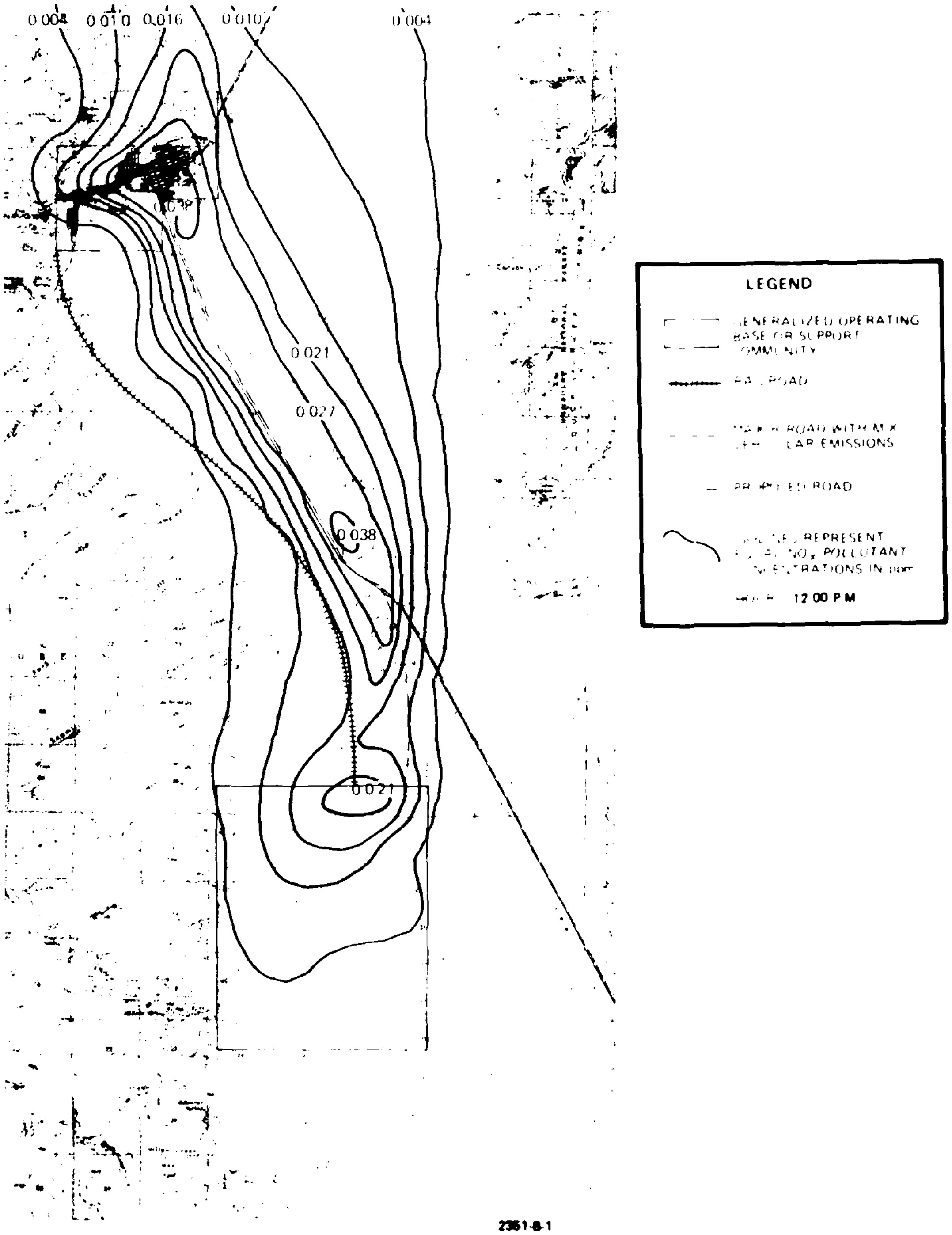


Figure 5.1.5-46. Predicted hourly NO_x concentrations at the Ely OB site and community.

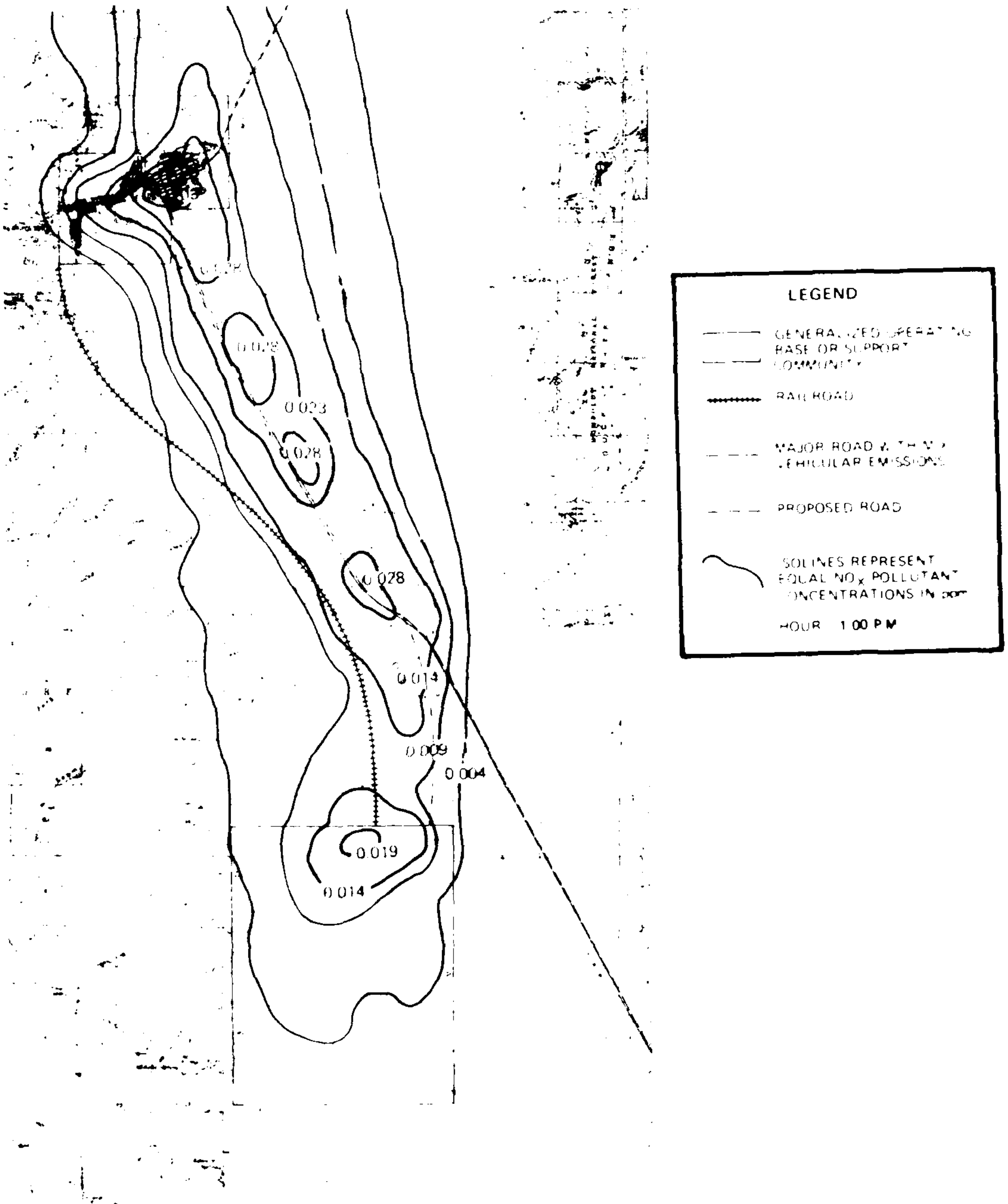


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Figure 5.1.5-47. Predicted hourly NO concentrations at the Ely OB site and community.

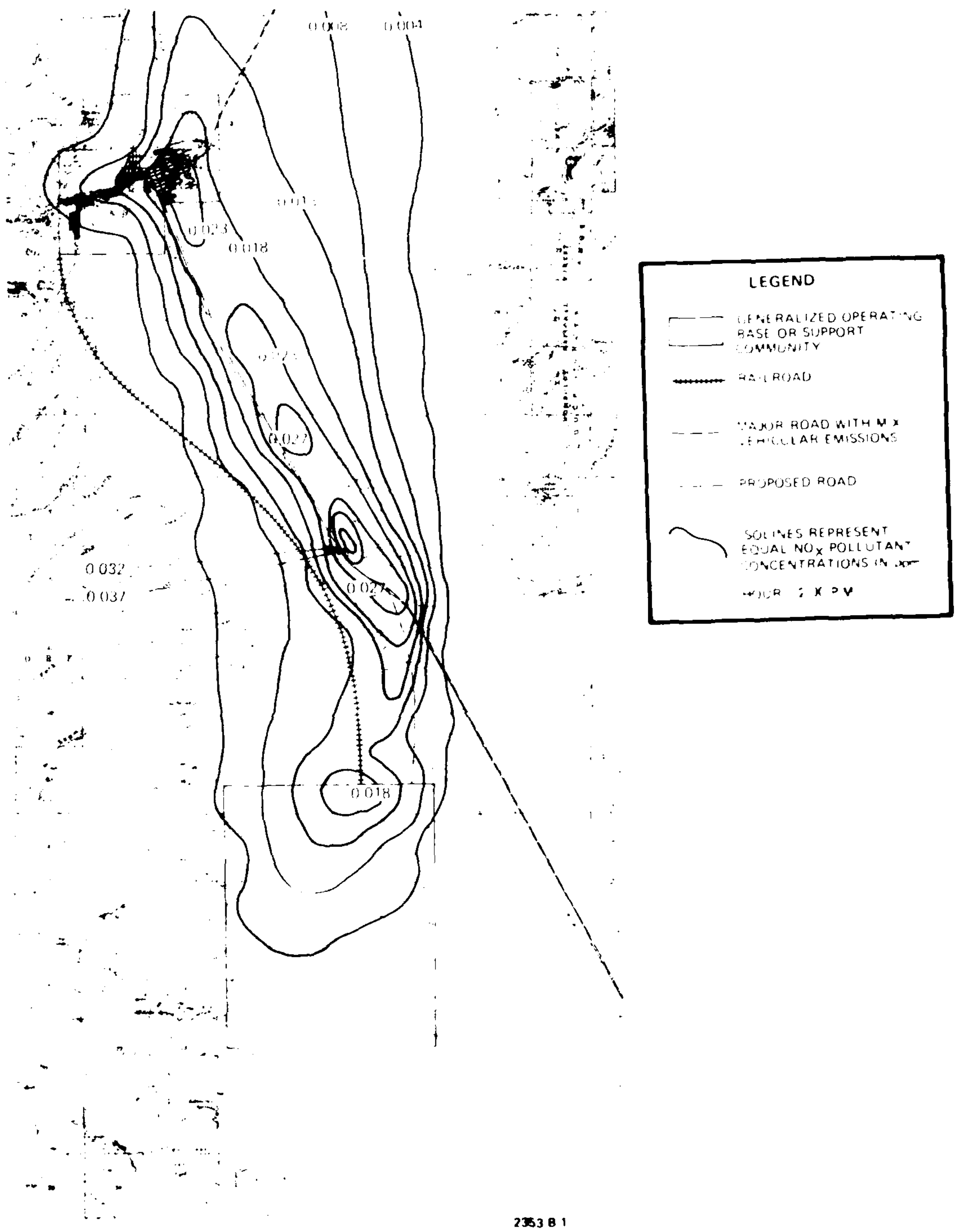
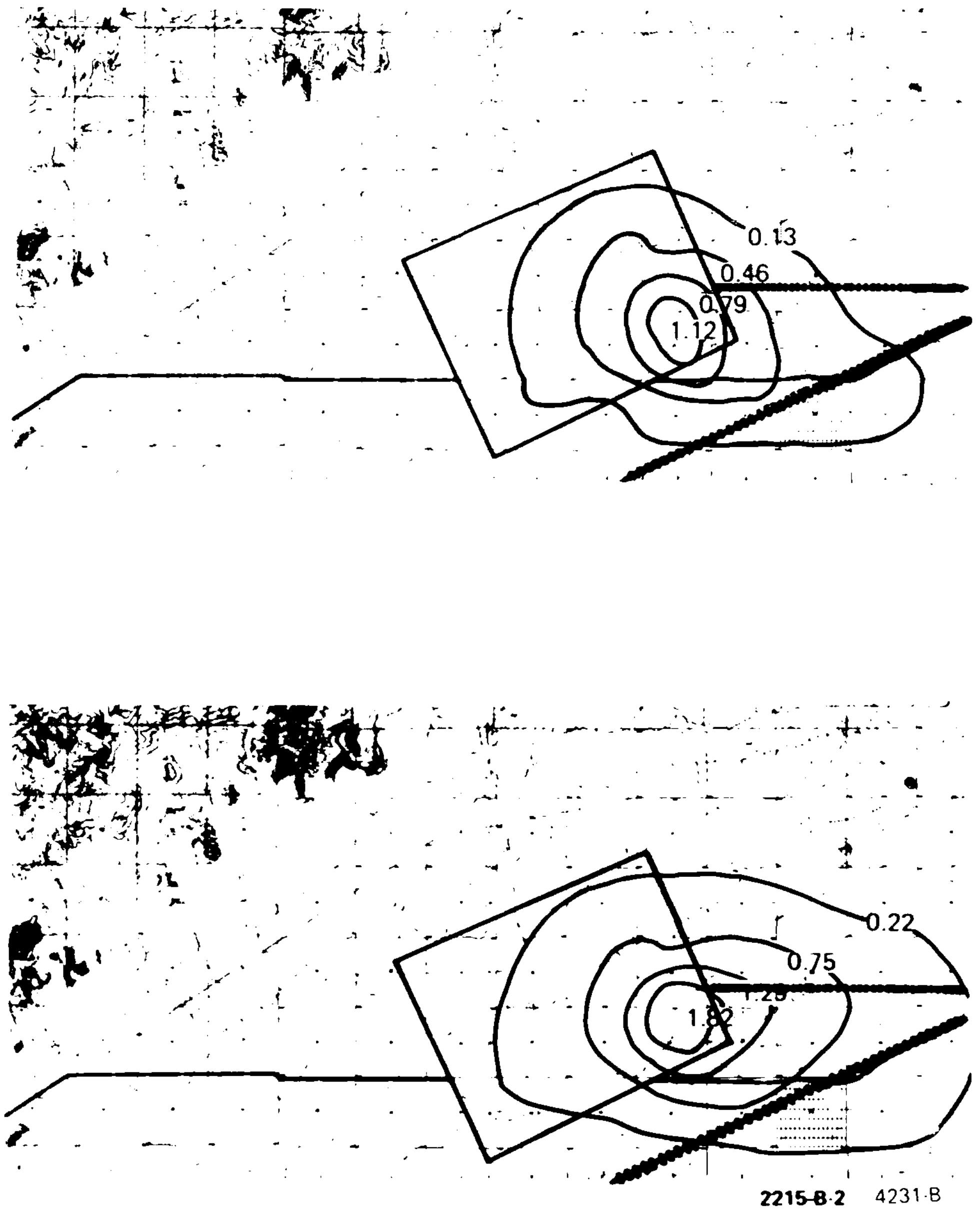


Figure 5.1.5-48. Predicted hourly NO_X concentrations at the Ely OB site and community.

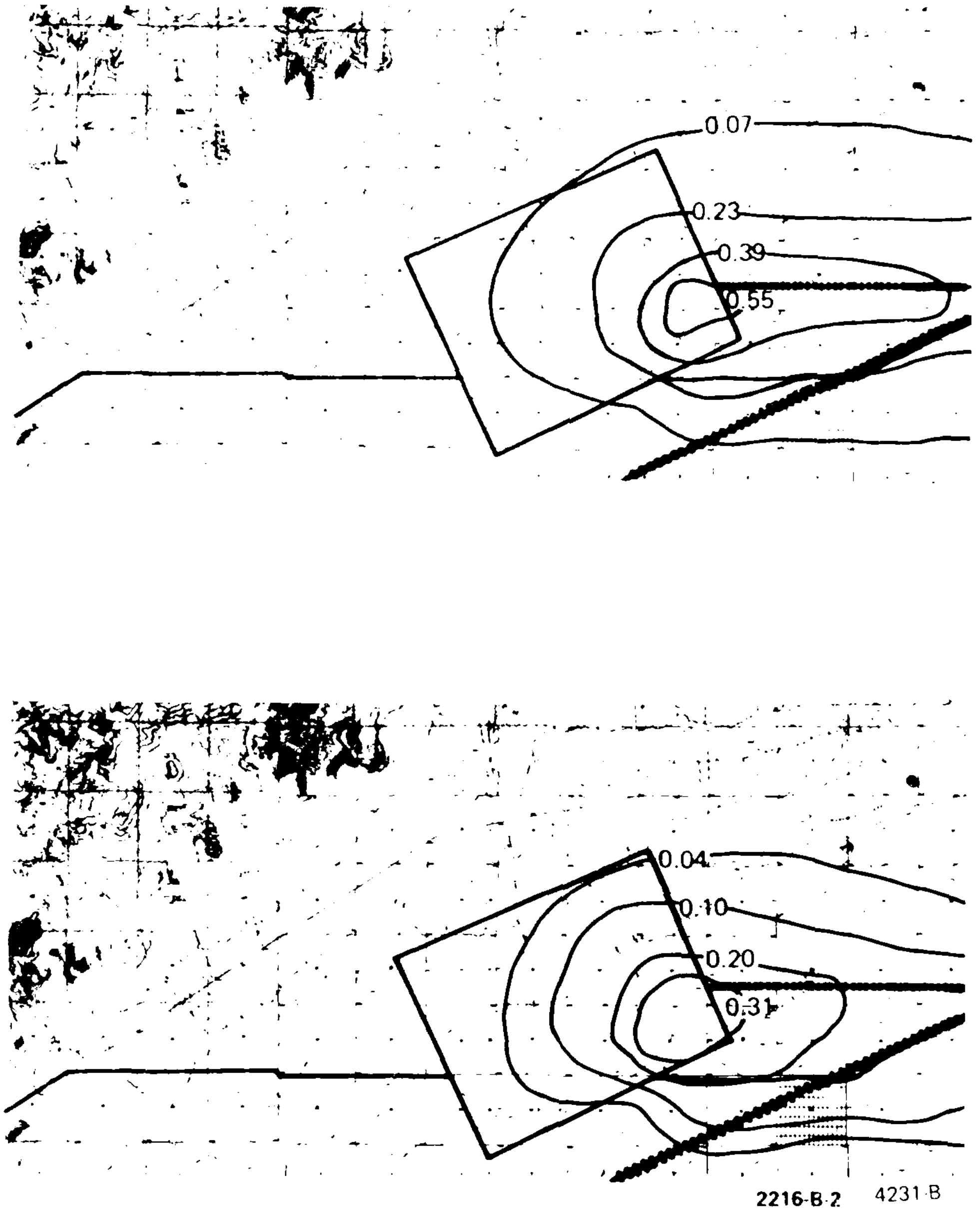


LEGEND

- GENERALIZED OPERATING BASE OR SUPPORT COMMUNITY
- RAILROAD
- MAJOR ROAD WITH M X VEHICULAR EMISSIONS
- ISOLINES REPRESENT EQUAL CO POLLUTANT CONCENTRATIONS IN ppm

HOUR **8:00 A.M. (TOP) 9:00 A.M. (BOTTOM)**

Figure 5.1.5-49. Predicted hourly CO concentrations at the Beryl OB site.



LEGEND

GENERALIZED OPERATING BASE OR SUPPORT COMMUNITY

RAILROAD

MAJOR ROAD WITH M X VEHICULAR EMISSIONS

ISOLINES REPRESENT EQUAL CO POLLUTANT CONCENTRATIONS IN ppm

HOUR **10:00 A.M. (TOP) 11:00 A.M. (BOTTOM)**

Figure 5.1.5-50. Predicted hourly CO concentrations at the Beryl OB site.

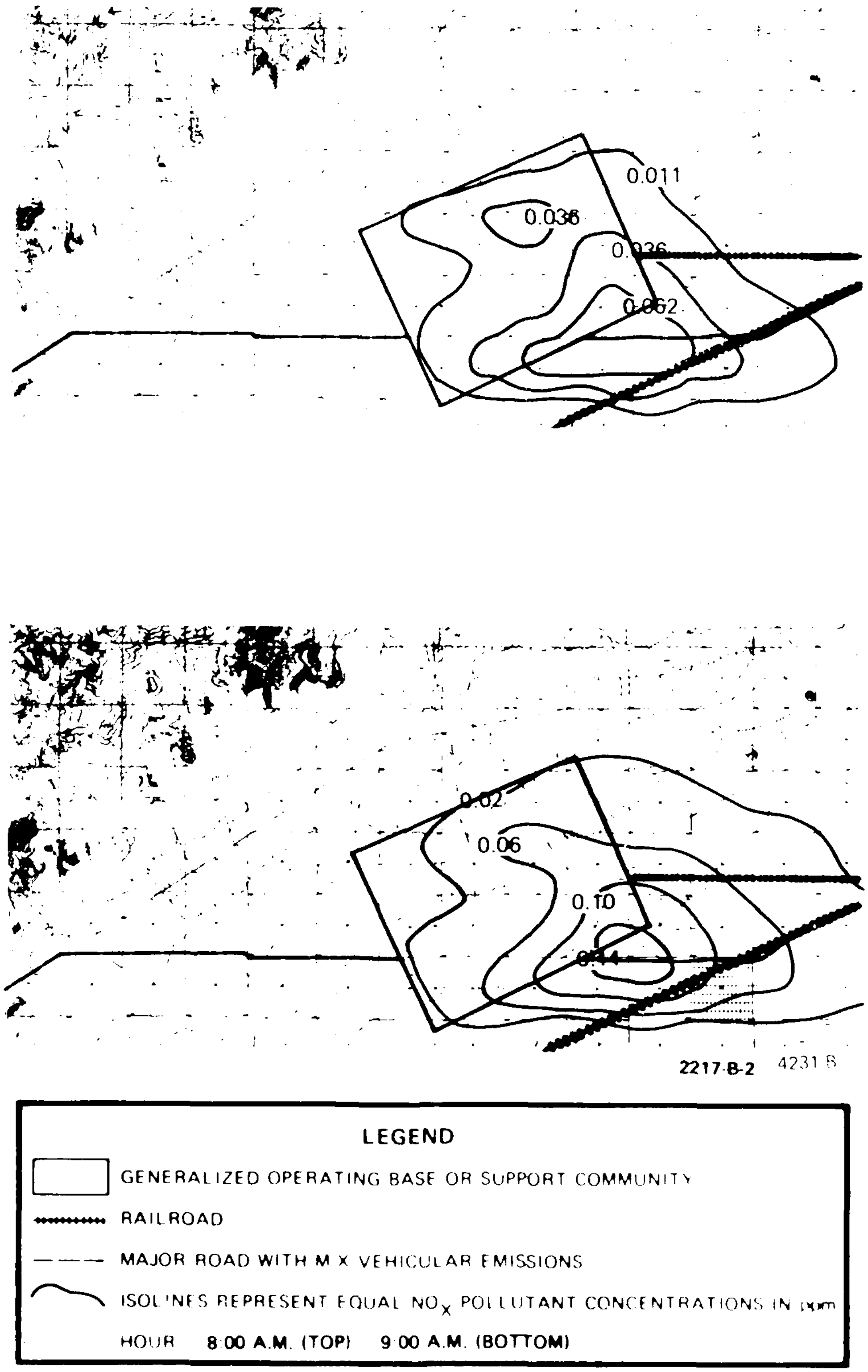


Figure 5.1.5-51. Predicted hourly NO_X concentrations at the Beryl OB site.

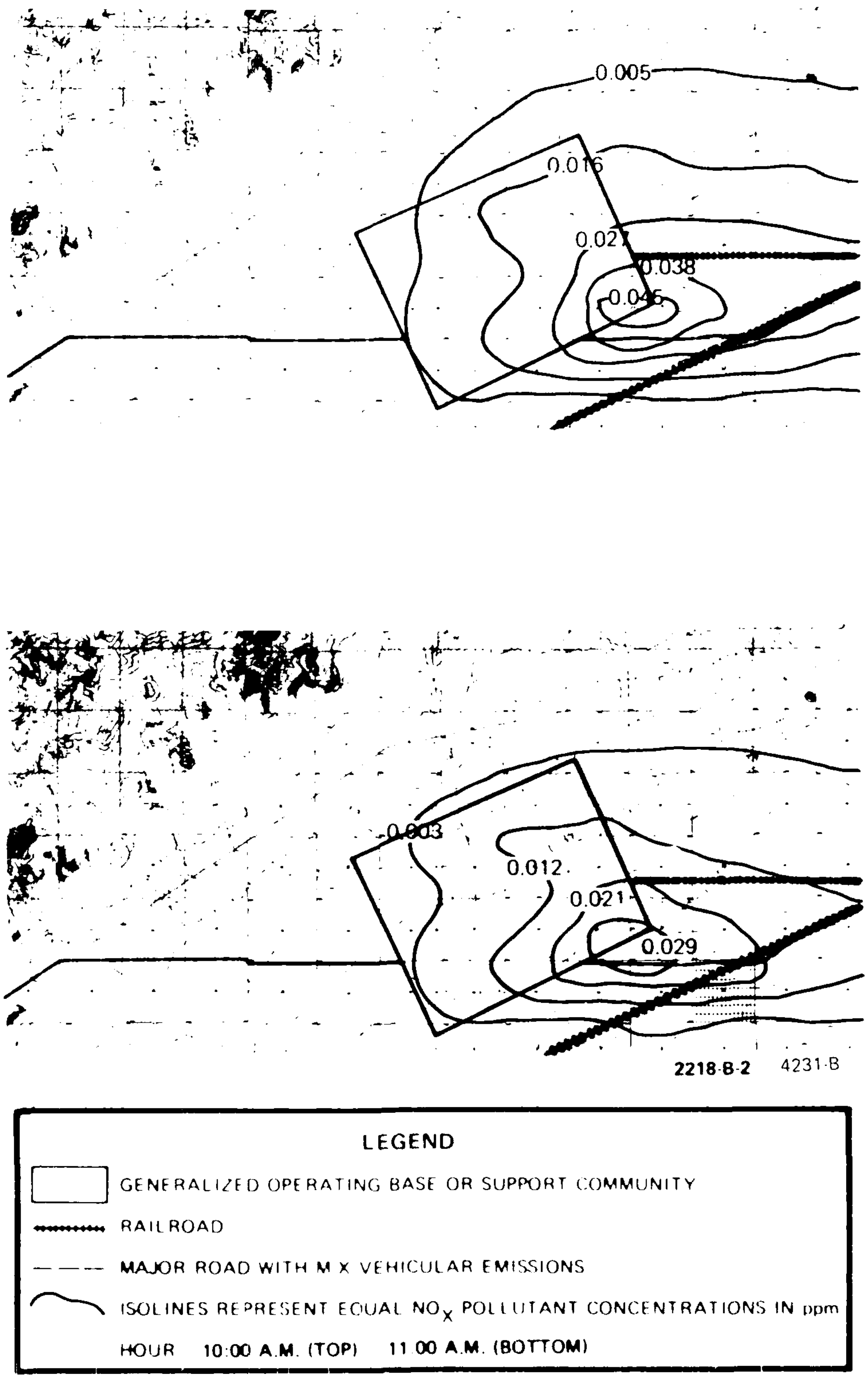
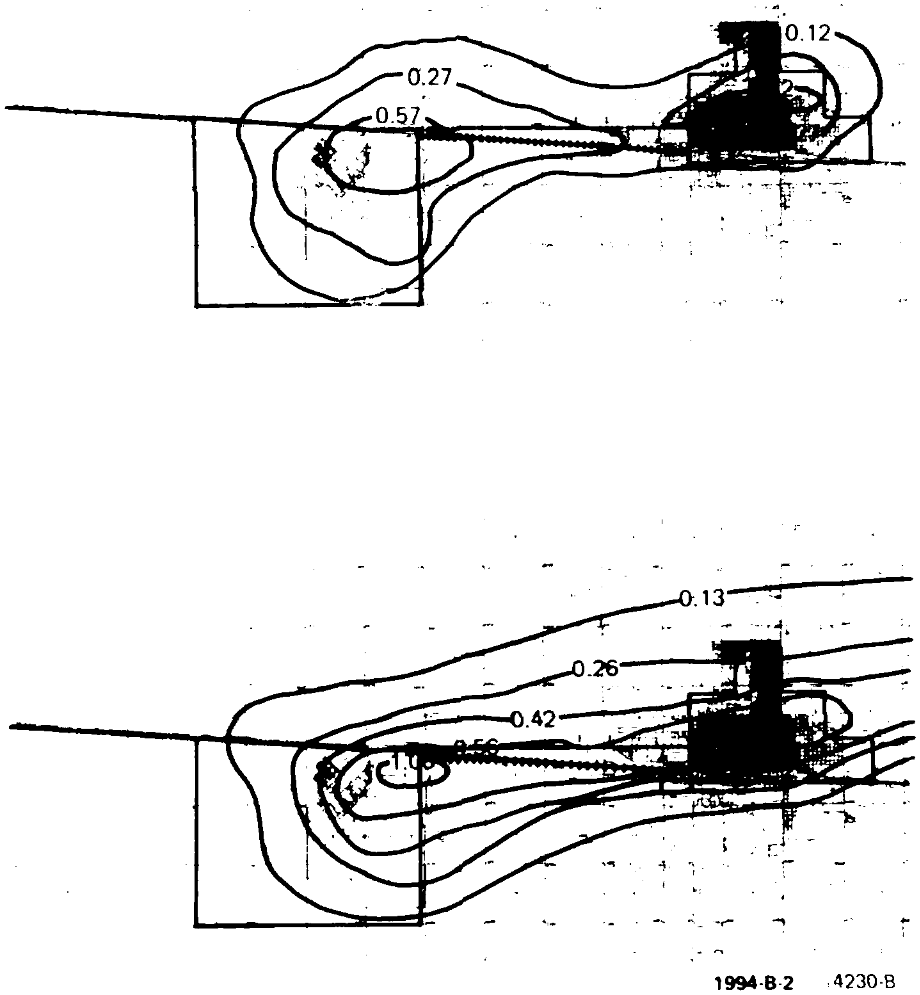


Figure 5.1.5-52. Predicted hourly NO_X concentrations at the Beryl OB site.



LEGEND

GENERALIZED OPERATING BASE OR SUPPORT COMMUNITY

RAILROAD

MAJOR ROAD WITH M X VEHICULAR EMISSIONS

ISOLINES REPRESENT EQUAL CO POLLUTANT CONCENTRATIONS IN ppm

HOUR **8:00 A.M. (TOP) 9:00 A.M. (BOTTOM)**

Figure 5.1.5-53. Predicted CO concentrations at the Clovis OB site and community.

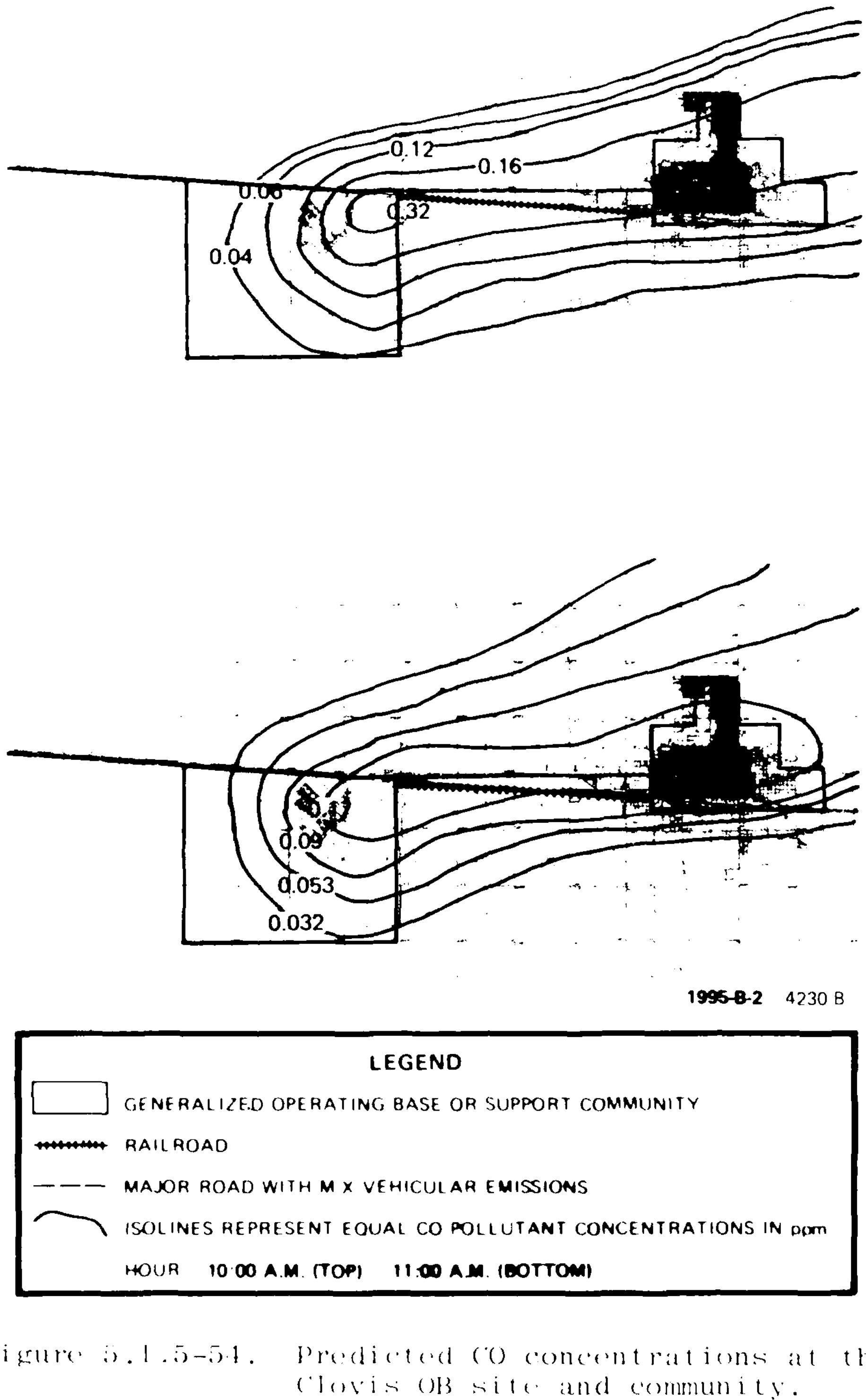


Figure 5.1.5-54. Predicted CO concentrations at the Clovis OB site and community.

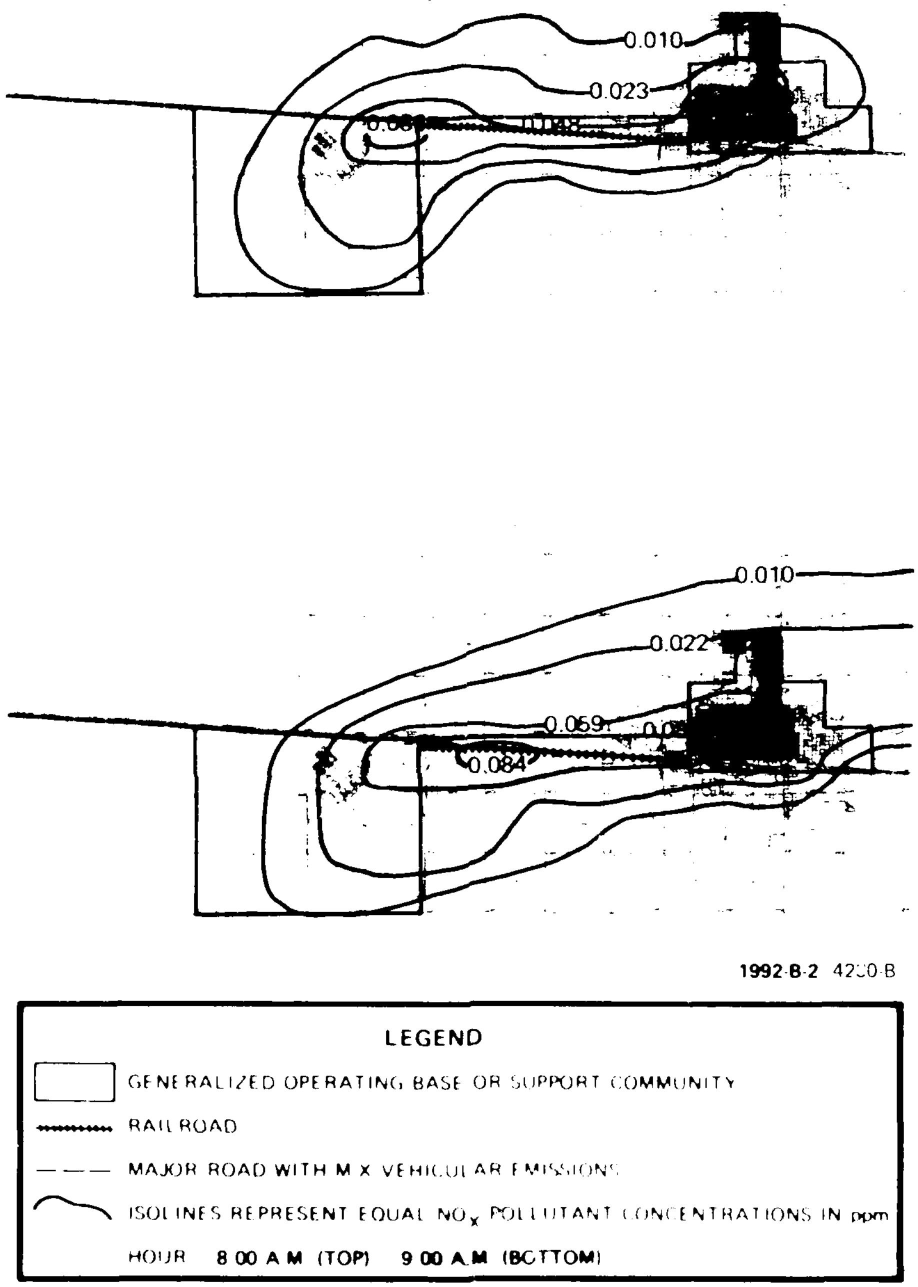
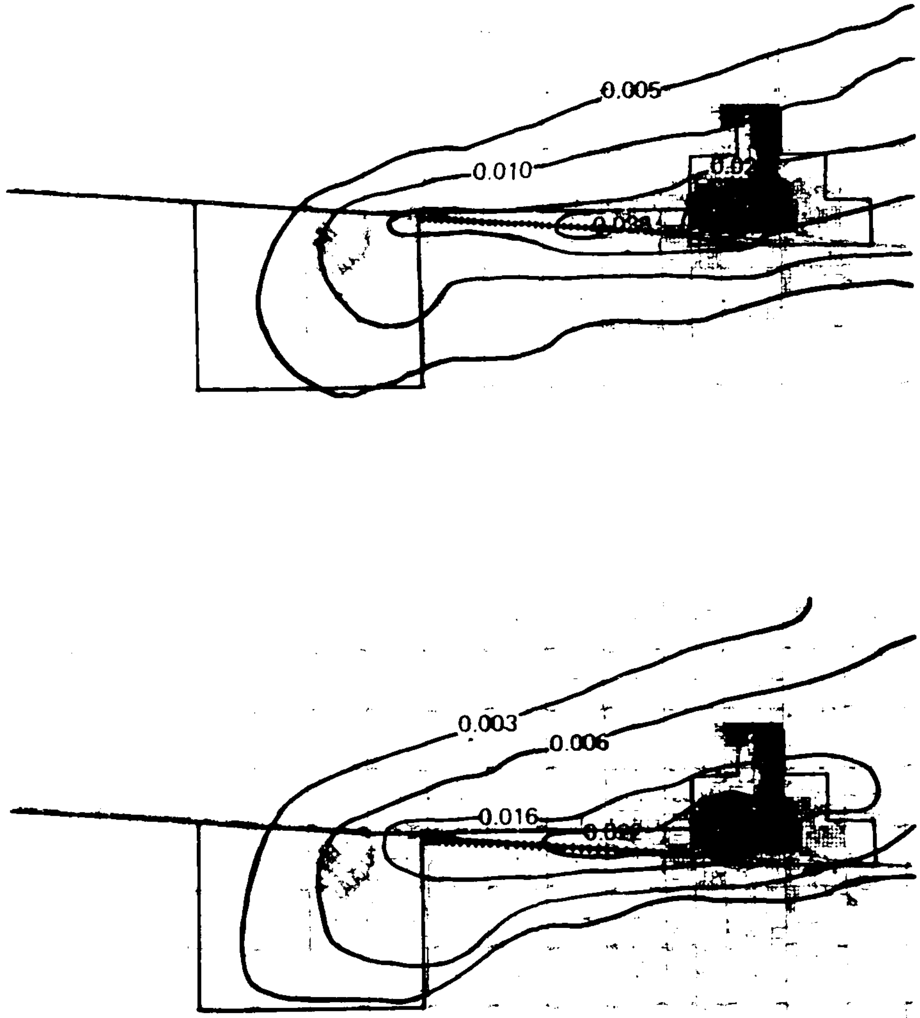


Figure 3.1.5-55. Predicted NO_x concentrations at the Clovis OB site and community.



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LEGEND

- GENERALIZED OPERATING BASE OR SUPPORT COMMUNITY
- RAILROAD
- MAJOR ROAD WITH M X VEHICULAR EMISSIONS
- ISOLINES REPRESENT EQUAL NO_X POLLUTANT CONCENTRATIONS IN ppm

HOUR 10:00 A.M. (TOP) 11:00 A.M. (BOTTOM)

Figure 5.1.5-56. Predicted NO_X concentrations at the Clovis OB site and community.

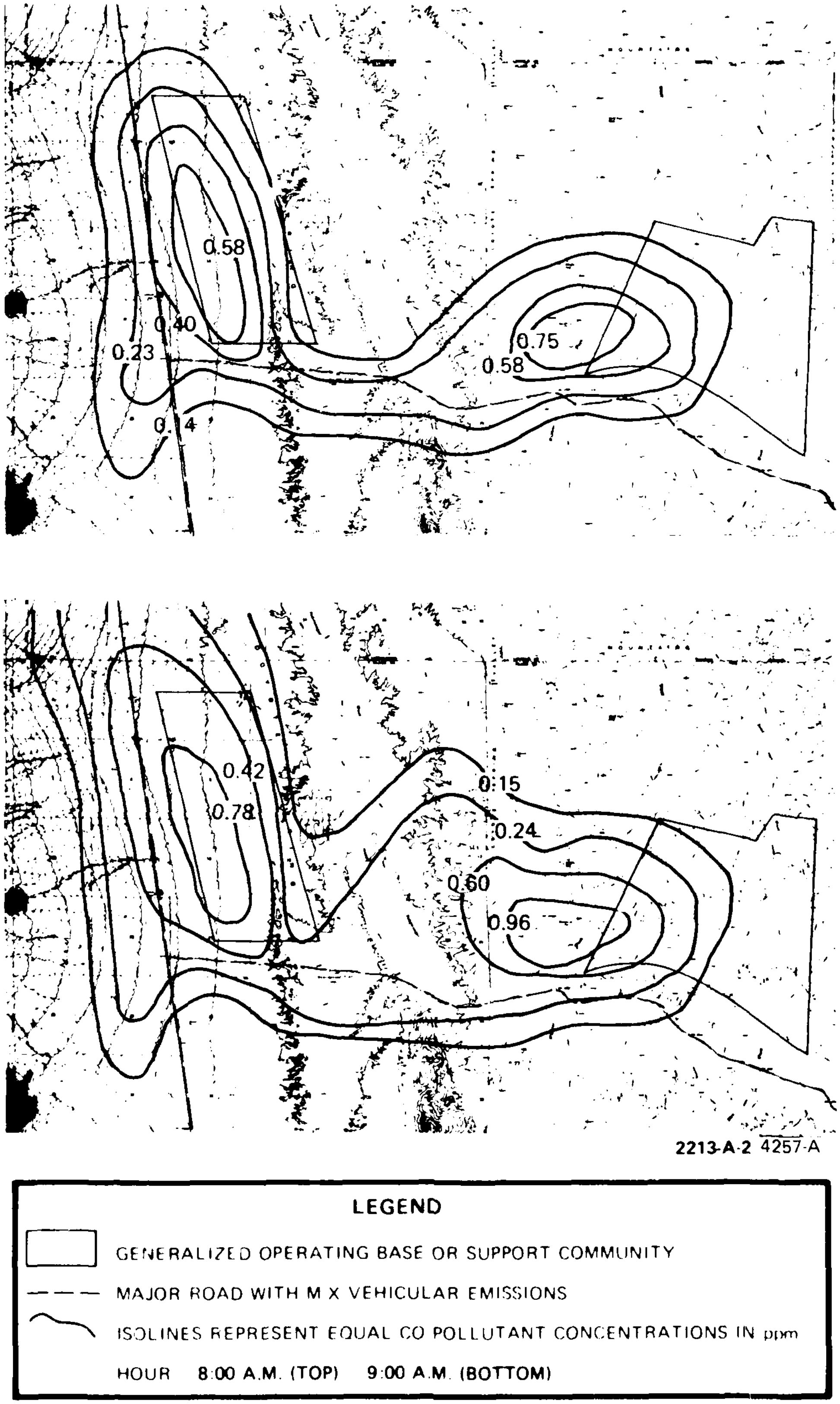


Figure 5.1.5-57. Predicted hourly CO concentrations at the Coyote Spring OB site.

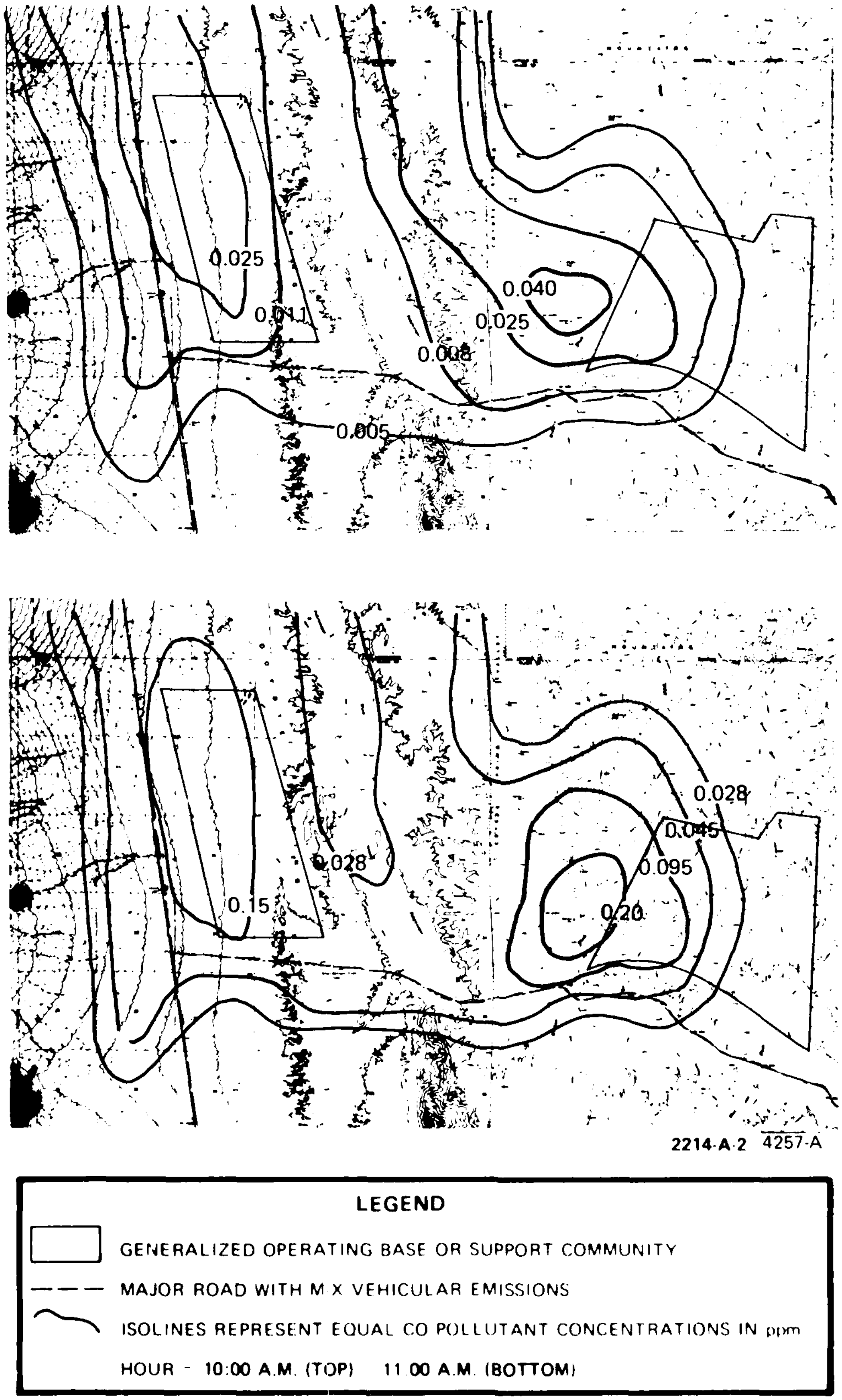


Figure 5.1.5-58. Predicted hourly CO concentrations at the Coyote Spring OB site.

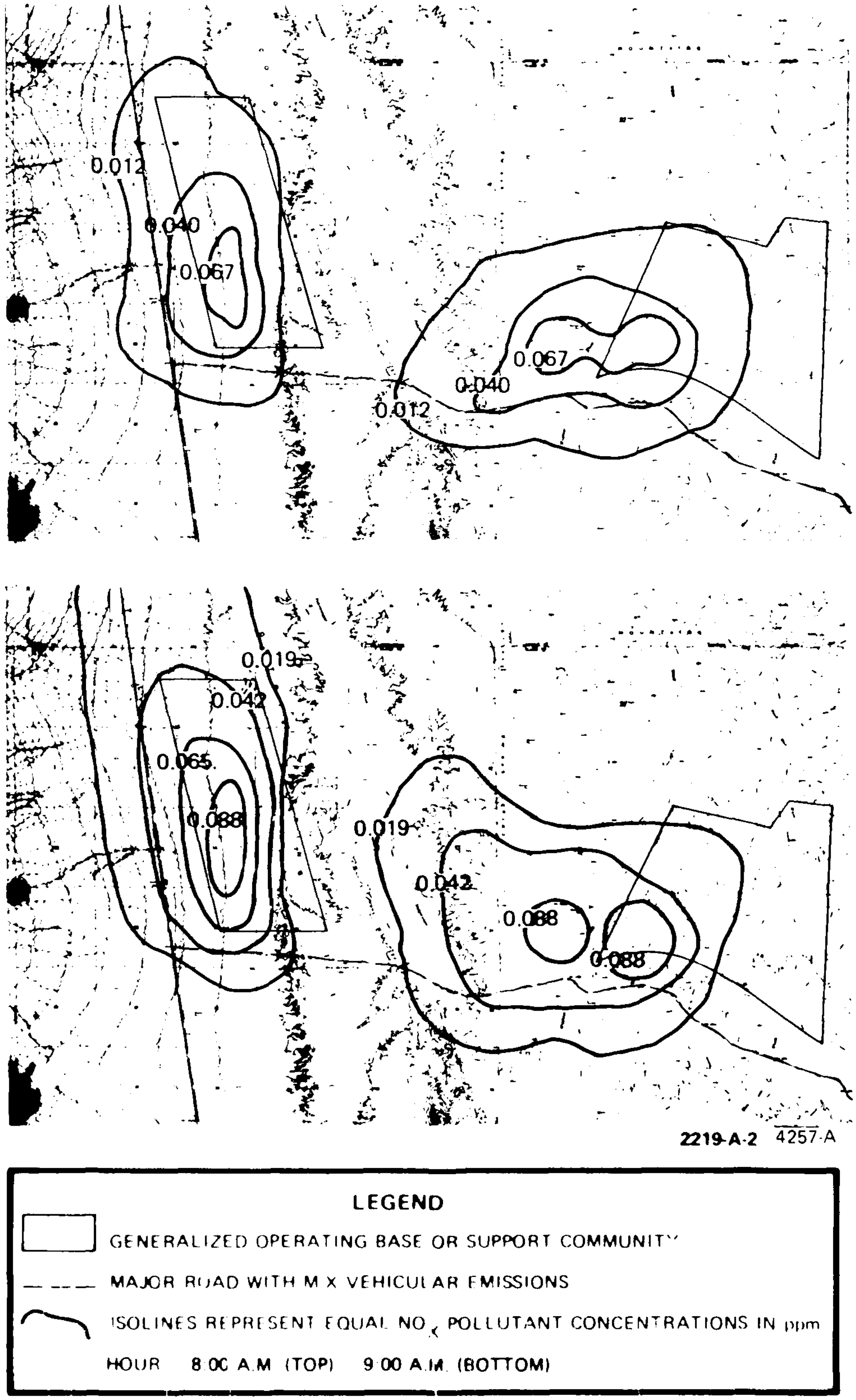
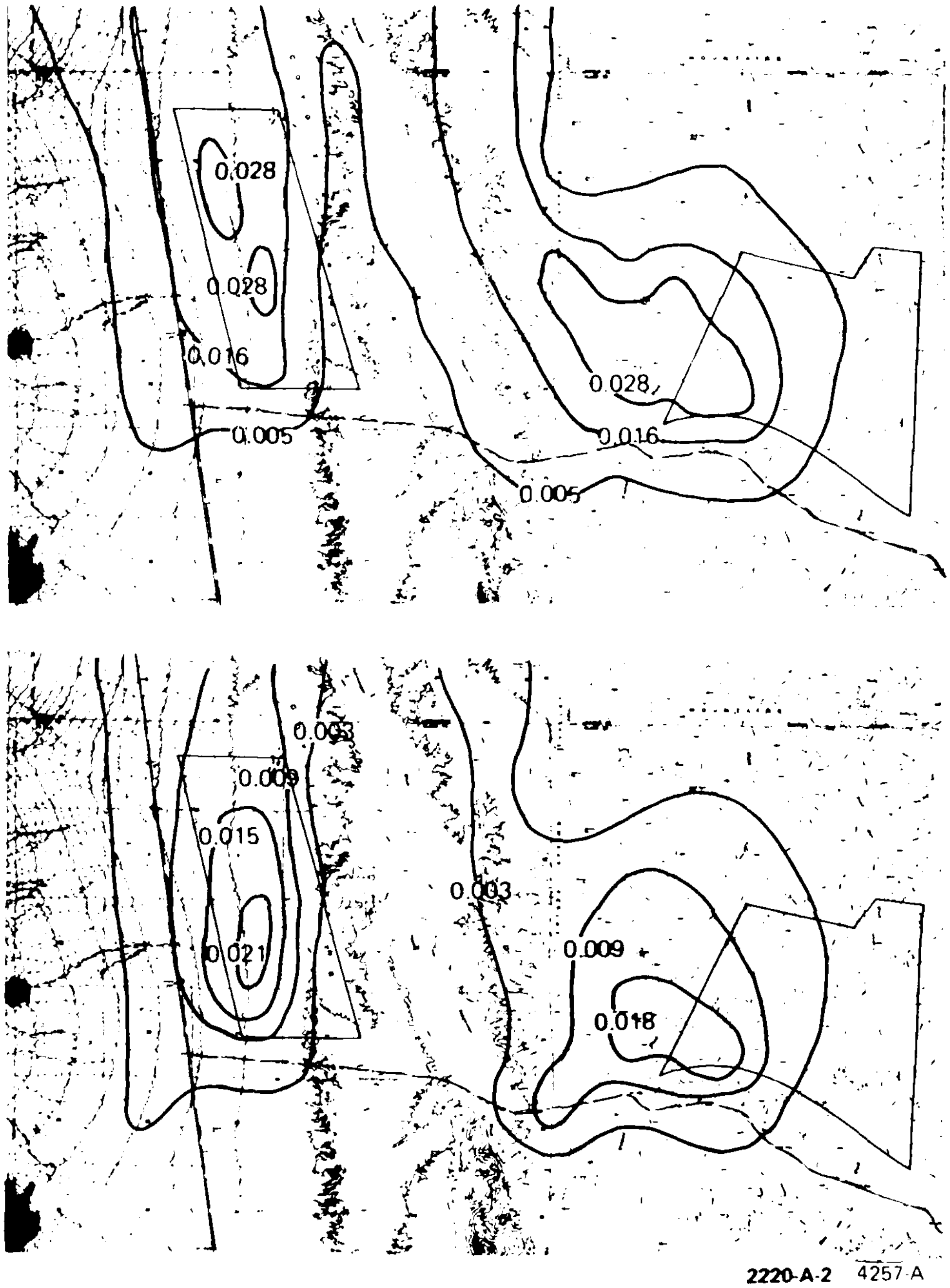


Figure 5.1.5-59. Predicted hourly NO_x concentrations at the Coyote Spring OB site.



LEGEND

GENERALIZED OPERATING BASE OR SUPPORT COMMUNITY

MAJOR ROAD WITH M X VEHICULAR EMISSIONS

ISOLINES REPRESENT EQUAL NO_X POLLUTANT CONCENTRATIONS IN ppm

HOUR 10 00 A.M. (TOP) 11 00 A.M. (BOTTOM)

Figure 5.1.5-60. Predicted hourly NO_X concentrations at the Coyote Spring OB site.

Table 5.2-1. NO_x concentrations from construction equipment emissions.

Highway version: 78010

Endpoints of the Line Source

0.000, -5.000 and 0.000, 5.000

Emission Height is 1.000 meters

Emission Rate (grams/second/meter) of 1 Lane(s) 0.0023.

Width of At-Grade Highway is 20.0 meters

Width of Center Strip is 0.0 meters

Wind Direction is 270. degrees

Wind Speed is 1.0 meters/sec.

Stability Class is 6

Height of Limiting Lid is 25.0 meters

The scale of the Coordinate Axes is 1.0000 km/user unit.

Receptor X	Location Y	Height Z(M)	Concentration $\mu g/m^3$	PPM*
.0250	0.0000	2.0000	553.	.482
.0500	0.0000	2.0000	519.	.451
.1000	0.0000	2.0000	443.	.385
.5000	0.0000	2.0000	195.	.169
1.0000	0.0000	2.0000	125.	.109

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release. Performing a similar analysis as above with the HIWAY model would provide CO concentration levels below those of the NO_x case. The CO 1-hour federal standard of 40 mg/m^3 (40,000 μ/m^3) is much higher than the NO_x concentration result of 519 $\mu g/m^3$ and therefore no significant air quality impact would be expected from CO release. HC emissions are predicted to be approximately one-tenth of the NO_x emissions. Therefore predicted concentrations are approximately 52 μ/m^3, less than the federal 3-hour guideline (160 μ/m^3).

OPERATION-RELATED VEHICULAR IMPACTS (5.2.2)

The effects of traffic emissions associated with OB operation were estimated through the use of the EPA HIWAY line source model. Emission factors for various vehicle volumes were determined in accordance with "EPA Mobile Source Emission Factors" (1978). As a specific vehicle mix of vehicle age and type and average vehicle speed data were not available, the national average mix, 1975 vehicles, and a speed of 45 mph were assumed. Table 4.1.3-3 shows emission factors for CO, HC and NO_x at selected vehicle volumes. Meteorological conditions were chosen which would insure conservative results: wind speed of one meter/sec; stability Class F (moderately stable atmosphere); 25 meters mixing height. Figure 5.2-1 depicts concentrations occurring when the wind direction is 45 degrees with respect to the roadway. A direction of 45 degrees was chosen as it has been determined that HIWAY under-predicts for crosswind cases and over-predicts for parallel wind cases (Noll, Miller, and Claggett, 1978).

Of the three pollutants modeled, CO is of most concern on a local basis. The results presented in Figure 5.2-1 indicate that for 8-hour average vehicle volumes of up to 10,000 vehicles per hour on a single roadway the CO 8-hour standard would not be violated at a distance of 50 meters. Table 5.2-2 presents the vehicle volumes and resultant concentrations of pollutants associated with peak hour OB traffic. At peak hour traffic levels, maximum CO concentrations will only be about 10 percent of the Federal 1-hour standard of 40,000 $\mu g/m^3$.

OB OPERATIONS

Predicted traffic volumes are not sufficient to cause a violation of the CO standard. The 3-hr HC guideline may be exceeded at each OB site. The HC guideline is designed to assist in attaining the oxidant standard. There is not expected to be an oxidant problem due to the OB. Oxidant modeling may be conducted under the subsequent tiered decisionmaking process of the environmental assessment when more refined base emissions data are available.

Predicted peak hourly NO_x concentrations are greater than the annual standard. As a benchmark for comparison the California 1-hour NO_x standard of 470 $\mu g/m^3$ would be exceeded at some of the OBs. Peak predicted concentrations presented here are expected to occur only during rush hour traffic. Annual NO_x concentrations are anticipated to be significantly less than the peak hourly values. Long-term meteorological data is necessary in order to make annual concentration predictions. A monitoring program to collect such data at several operating base sites has begun as part of anticipated future tier decisionmaking.

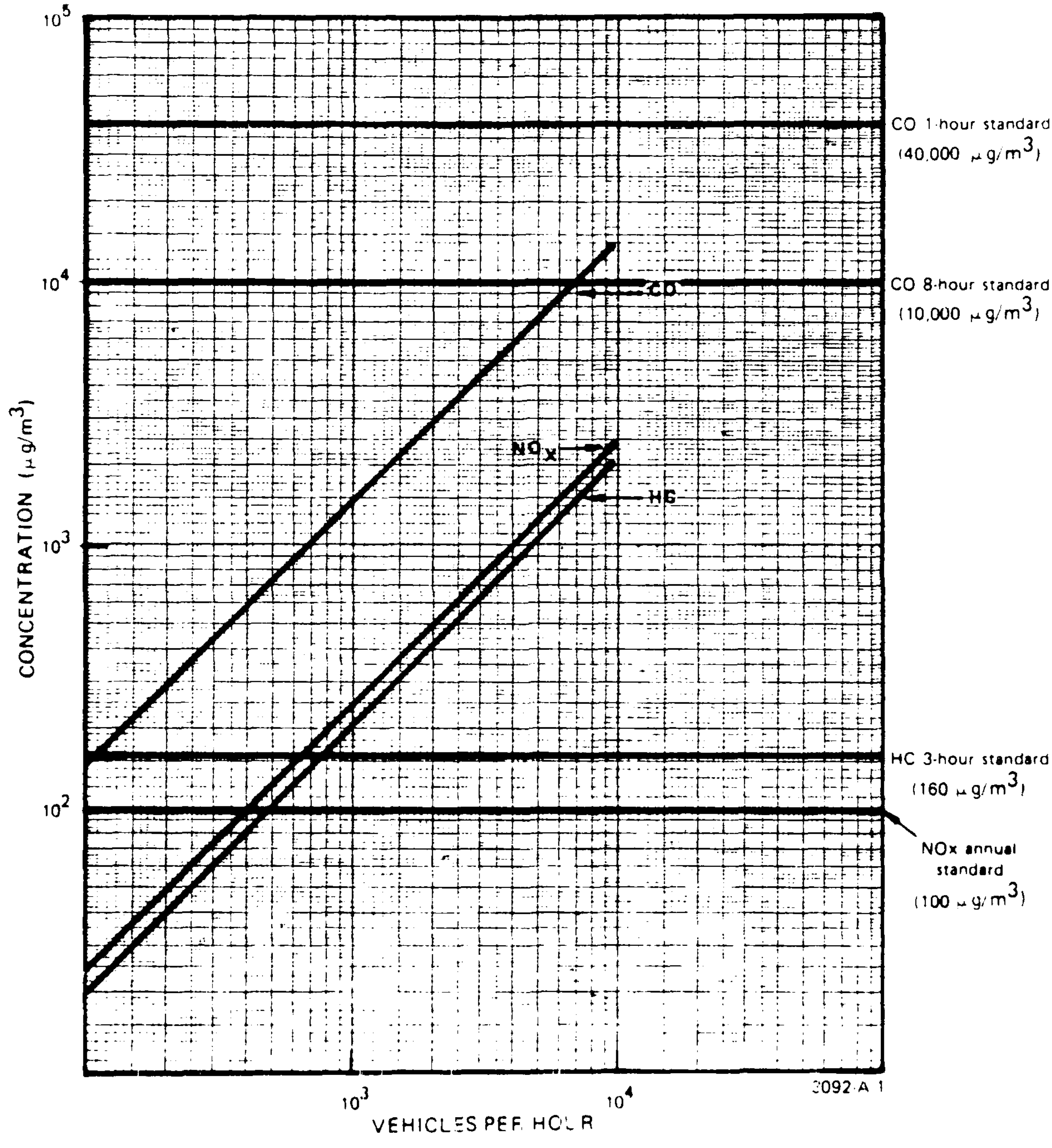

Figure 5.2-1. Pollutant concentration at 50 meters from the roadway vs. vehicle volume.

Table 5.2-2. Traffic-related concentrations (1 hour averages).

OPERATING BASE	PEAK HOUR TRAFFIC (VEHICLES/HOUR)	CONCENTRATIONS ($\mu g/m^3$)		
		CO	HC	NO_x
Coyote Spring, NV				
Baseline	85	<100	<20	<25
Baseline + M-X	2,125	3,000	400	500
Beryl, UT				
Baseline	69	<100	<20	<25
Baseline + M-X	1,854	2,700	370	460
Ely, NV				
Baseline	273	390	55	65
Baseline + M-X	1,643	2,300	320	380
Delta, UT				
Baseline	80	<100	<20	<25
Baseline + M-X	1,910	2,800	400	480
Clovis, NM				
Baseline	1,144	1,600	220	270
Baseline + M-X	3,244	4,400	640	740
Dalhart, TX				
Baseline	593	820	120	150
Baseline + M-X	2,198	3,100	420	520

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5.3 PAL MODELING RESULTS

CONSTRUCTION-RELATED PARTICULATE POLLUTANT IMPACTS (5.3.1)

Particulate pollutant construction-related impacts at the local level were assessed using the Point Area Line (PAL) and Industrial Source Complex (ISC) models. Construction-related dust emissions will result from a variety of source configurations and all dust emissions will be released at or near the ground. Dust emissions will be emitted from vehicular traffic over roads (linear sources), as wind erosion from exposed surfaces (area sources) and from general construction activity (area sources). A model was required that could simulate the emission and dispersion of particulates from area and line ground-level emission sources. Both PAL and ISC models have this capability.

In Nevada/Utah, the additional model capability to simulate the effect of complex terrain or pollutant dispersion was also desirable. For example, the IMPACT model was preferable for modeling the regional-scale particulate impacts because of its unique simulation of complex terrain meteorological conditions. However, there is no acceptable model for the local impacts that can both simulate area and line sources which also incorporates an algorithm simulating the influence of complex terrain on pollutant dispersion (USEPA Research, 1978). The VALLEY model, which is widely used, will simulate the effect of pollutants impacting an elevated surface (such as a ridge, or hillside), but it does not satisfactorily incorporate emissions from an area or line source. It was considered most important to adequately simulate the emission configuration, that is, the combination of area and line sources. The other option, that of placing all the emissions for a given area at one point, was considered to be unacceptable. For these reasons, the PAL and ISC models were used.

For a variety of reasons, the ISC model is considered superior in the application of area fugitive dust sources to the PAL model. The most significant advantage in the ISC model is the ability to incorporate particle gravitational settling and dry deposition. The PAL model does not have a mechanism for simulating particle settling and deposition and therefore predicted particulate concentrations are higher than would be realistically expected. Use of the ISC model for wind erosion emissions (Section 5.5) indicates that use of the gravitational settling and deposition option results in predicted concentrations that are two to three times greater than the cases in which no settling is assumed.

The ISC model is a relatively new model (Bowers, Bjorkland, Cheney, 1979) and was used in combination with the old PAL model to predict particulate impacts. The PAL model was used to predict particulate concentrations due to construction in the deployment area and the ISC model was used to predict particulate concentrations due to construction activity at the operating base. Both results are presented here.

The PAL model was used to analyze potential local impacts of fugitive dust emissions from point, area, and line sources associated with construction activities. As discussed earlier, overly conservative results were assured due to the dispersion assumptions utilized by the model: (1) no settling of dust occurs and (2) there is complete reflection of dust particles at the terrain surface. These assumptions of no deposition and complete reflectivity effectively increase the predicted concen-

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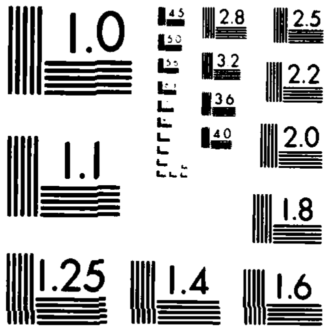

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tration levels, which is consistent with a worst-case analysis. It is not anticipated that the levels of dust predicted by the model will actually exist. To put the modeling results in perspective, the quantities of fugitive dust from M-X construction activities are primarily generated by heavy-duty earth-moving equipment similar to that used in highway construction programs. Thus, the quantities of dust raised are characteristic of other large construction efforts. A dust problem would be expected close to construction activities and is confirmed by initial modeling.

Tables 5.3-1 and 5.3-2, and Figure 5.3-1 present the results of the PAL model for selected emission sources associated with the construction activity in the deployment area and at the operating bases. Due to the limitations of modeling fugitive dust with PAL, as discussed above, the results should be viewed as indicating that extremely high levels of futgitive dust will exist near the construction activity, but not necessarily at the reported concentrations. Prerequisites for a more precise analysis are (1) a more sophisticated fugitive dust dispersion and transport algorithm, (2) site-specific meteorological data, (3) detailed construction scheduling information, and (4) a delineation of mitigation measures which will be applied. Research into state-of-the-art fugitive dust modeling techniques is in progress, and potential improvements to existing models are being evaluated.

The Army Corps of Engineers, the construction agent for M-X, will assure that the best available control technology and commonly accepted engineering procedures will be used to control construction dust and mitigate its effects. In addition, localized air quality effects due to construction dust are temporary because as roads and shelters are constructed, the construction activity moves to the next construction locale. The construction period for an individual shelter is approximately one month.

During the operational phase of M-X, the only project-induced fugitive dust emissions expected in individual deployment areas will be from wind erosion and vehicular traffic necessary for system security and maintenance. Analyses of particulate concentrations during operations are not possible until specific data on maintenance and security traffic are available.

The PAL modeling results indicate that particulate concentrations within four km of the construction activity in either the Nevada/Utah or Texas/New Mexico deployment area may exceed primary and secondary 24-hr NAAQS and the PSD Class II increment. Hourly predicted concentrations in Nevada/Utah for the three sources modeled range from 120 to 15,000 $\mu g/m^3$ depending on the source, mitigated or nonmitigated emission rates, the distance from the source, and the meteorological conditions. Hourly predicted concentrations at four km from the three sources modeled using mitigated emission rates range from 120 to 1100 $\mu g/m^3$.

Peak concentrations for Texas/New Mexico are very similar to those predicted for Nevada/Utah. Texas/New Mexico predicted 24-hr concentrations, using mitigated emissions at four km from the source, vary from 110 to 790 $\mu g/m^3$.

It is important to keep in mind when comparing the PAL and ISC modeling results with the IMPACT modeling results that not only do modeling algorithms

Table 5.3-1. Localized particulate conditions due to construction activity as predicted by the PAL model: Nevada/Utah.

METEOROLOGICAL CONDITIONS				SOURCE TYPE	ONE HOUR CONCENTRATIONS (ug/m^3) DOWNWIND			
					0.5 KM		4.0 KM	
OBSERVATION	MIXING HEIGHT (METERS)	WINDSPEED (ms^{-1})	STABILITY CLASS		NON-MITIGATED EMISSIONS	MITIGATED EMISSIONS	NON-MITIGATED EMISSIONS	MITIGATED EMISSIONS
Worst 1-Day Observation[a]	116	3.3	E	Shelter area[b] (10 acres)	2.0×10^3	1.0×10^3	2.5×10^2	1.2×10^2
				2 km segment of[c] cluster road	3.3×10^3	9.4×10^2	8.9×10^2	2.5×10^2
				2 km segment of DTN road[d]	1.0×10^4	2.9×10^3	2.7×10^3	7.8×10^2
Worst 5-day Observation[a]	277	2.3	E	Shelter area[b] (10 acres)	3.0×10^3	1.5×10^3	3.6×10^2	1.8×10^2
				2 km segment of[c] cluster road	4.8×10^3	1.4×10^3	1.3×10^3	3.6×10^2
				2 km segment of DTN road[d]	1.5×10^4	4.1×10^3	3.9×10^3	1.1×10^3

2992

[a]From observations recorded at Ely, NV. from "Meteorological Episodes of Slowest Dilution in the Contiguous U.S.", G. Holzworth, Feb. 1974.

[b]High level construction activity factor of 1.8 ton/acre was used to calculate emission rate for non-mitigated case. Mitigation measures (oiling, watering, etc.) assumed to reduce emission rate by 50 percent for mitigated case.

[c]Road segment handles traffic to and from active cluster road construction area and the batch plant. Mitigation case assumes 50 percent reduction in emission rate due to oiling and watering, plus lower silt content, resulting in a net emission reduction of 72 percent. 45° wind direction, with respect to road.

[d]Road segment handles traffic to and from the cluster road construction area, shelter construction area, and batch plant. Other conditions same as Footnote [c].

Table 5.3-2. Localized particulate concentrations due to construction activity as predicted by the PAL model: Texas/New Mexico.

METEOROLOGICAL CONDITIONS				SOURCE TYPE	ONE HOUR CONCENTRATIONS (ug/m^3) DOWNWIND			
					0.5 KM		4.0 KM	
OBSERVATION	MIXING HEIGHT (METERS)	WIND SPEED (MS-1)	STABILITY CLASS		NON-MITIGATED EMISSIONS	MITIGATED EMISSIONS	NON-MITIGATED EMISSIONS	MITIGATED EMISSIONS
Worst 1-Day Observation[a]	100	3.6	E	Shelter Area[b] (10 acres)	1.9×10^3	1.0×10^3	2.3×10^2	1.2×10^2
				2 KM Segment of Cluster Road[c]	3.0×10^3	8.6×10^2	8.2×10^2	2.3×10^2
				2 KM Segment of DTN Road[d]	9.3×10^3	2.6×10^3	2.5×10^3	7.1×10^2
Worst 5-Day Observation[a]	539	5.1	E	Shelter Area[b] (10 acres)	1.3×10^3	6.5×10^2	1.6×10^2	8.0×10^1
				2 KM Segment of Cluster Road[c]	2.1×10^3	6.1×10^2	5.8×10^2	1.6×10^2
				2 KM Segment of DTN Road[d]	6.6×10^3	1.9×10^3	1.8×10^3	5.0×10^2

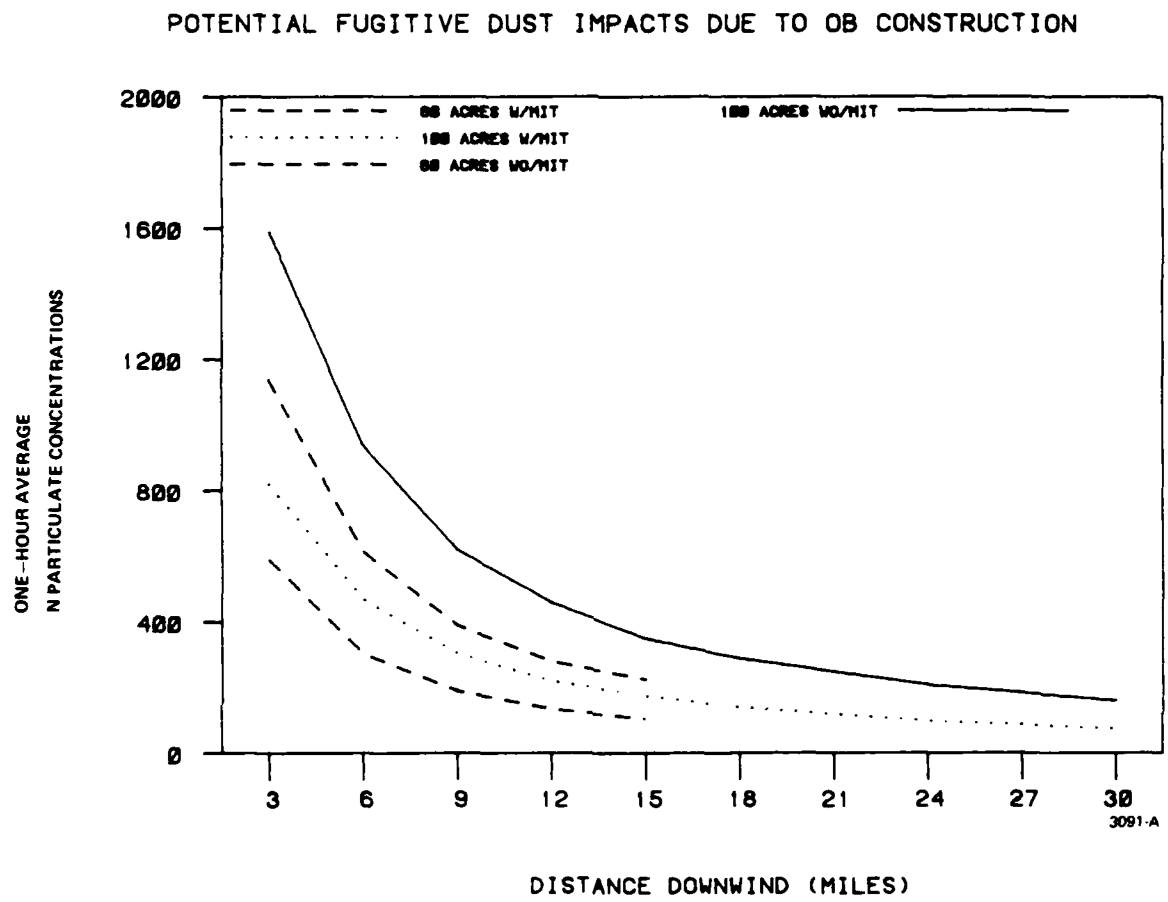
2965

[a]From observations recorded at Amarillo, TX, from Meteorological Episodes of Slowest Dilution in the Contiguous United States, G. Holzworth, Feb. 1974.

[b]High level construction activity factor of 1.8 ton acre was used to calculate emission rate for non-mitigated case. Mitigation measures (oiling, watering, etc.) assumed to reduce emission rate by 50 percent for mitigated case.

[c]Road segment handles traffic to and from active cluster road construction area and the batch plant. Mitigation case assumes 50 percent reduction in emission rate due to oiling and watering, plus lower silt content, resulting in a net emission reduction of 72 percent, 45° wind direction with respect to road assumed.

[d]Road segment handles traffic to and from the cluster road construction area, shelter construction area, and batch plant. Other conditions same as footnote c.



NOTE:

1.) CONCENTRATIONS ARE 1-HOUR AVERAGES, REPORTED IN MICROGRAMS PER CUBIC METER

2.) METEORLOGICAL CONDITIONS: WIND SPEED = 5 m/s, STABLE ATMOSPHERE, 500 METER MIXING HEIGHT.

3.) CONCENTRATIONS REPORTED FOR 60 AND 100 ACRES OF CONSTRUCTION ACTIVITY.

Figure 5.3-1. Potential fugitive dust impacts due to OB construction (PAL model, no particle settling).

differ but also the local-scale PAL and ISC models predict concentrations at geographically identified points, whereas the IMPACT concentrations are averaged over an area defined by a grid square. The PAL and ISC models identify local peak concentrations within a grid square.

CONSTRUCTION-RELATED GASEOUS POLLUTANT IMPACTS (POWER GENERATOR EMISSIONS) (5.3.2)

Preliminary emissions estimates presented in Tables 4.1.2-40 through 4.1.2-45 indicate high NO_x emissions may result from the diesel generators used to provide power for the stationary sources that produce and process construction materials. Refined modeling can take place when more refined equipment and site data become available under subsequent tiered decisionmaking of the environmental assessment.

Assumptions used for the preliminary modeling using the PAL model include:

- o three generators operated within a 30-acre facility
- o no control equipment
- o NO_x emissions rates for each generator was 3.0 g/sec
- o wind speed equals 3.0 meters/sec, Pasquill stability Class E (stable), and a mixing layer height of 60 meters.

The maximum predicted hourly NO_x concentration using the above assumptions was $836 \mu g/m^3$. For comparison, the NO_x annual NAAQS is 100 $\mu g/m^3$. Insufficient meteorological and emissions data was available to predict annual concentrations for direct comparison with the annual NO_x air quality standard. These results indicate a potential for a significant NO_x impact. Comparison of the maximum hourly NO_x concentration with the California 1-hour standard of $450 \mu g/m^3$ indicate that under these worst case meteorological conditions a significant NO_x impact could occur. Again, further analysis could be conducted under subsequent tier decisionmaking environmental assessment when appropriate mitigations are determined based on a more refined analysis.

5.4 ISC (INDUSTRIAL SOURCE COMPLEX) MODELING RESULTS - CONSTRUCTION-RELATED PARTICULATE IMPACTS AT THE OPERATING BASE

The Industrial Source Complex (ISC) model is an air pollutant dispersion model developed for EPA, only recently available. The model was tested and applied to the OB construction situation for comparison with the PAL model results for the deployment area construction activity impacts. The ISC modeling results are presented here.

The ISC model is superior to the PAL model for predicting particulate concentrations downwind of fugitive dust emissions from construction activity for several reasons. The ISC model was designed to combine and improve various algorithms from existing accepted air quality models in order to assess air pollutant concentrations and dry deposition from a variety of sources associated with an industrial source complex. Most importantly the ISC model accounts for

gravitational settling and dry deposition. For special ISC model options, the user can input site- or source-specific data. If more reliable data is not available for the modeled condition, the model will use preselected default values obtained from previous studies.

Particle size distribution, deposition velocity, and reflection data are not available for construction activity emissions. Values used in the model were obtained from ore pile emissions data given in the model documentation volume (Bowers, Bjorklund, Cheney, 1979), and are presented in Table 5.4-1.

Worst-case meteorological data at weather stations most representative of conditions at the operating bases are given in Table 5.4-2. The worst one-day and five-day conditions observed for pollutant dispersion during the period of record (1960-1964) are presented. The worst one-day observations, representing the conditions which would produce the highest pollutant concentrations, were selected to use in the ISC model.

The modeling results are presented in Figures 5.4-1 through 5.4-4 for all four options: 60 and 100 acres with mitigated or nonmitigated emission rates. The emissions included only represent those emissions for heavy construction activity (AP-42*) and do not include other related emissions such as materials production, processing, or excavation, or wind erosion since adequate data is not available. Additional modeling will be proposed during the subsequent tier decisionmaking of the environmental assessment process.

The results presented here are far more realistic than those presented earlier for the PAL model because of the refinements in pollutant predictions provided by the incorporation of pollutant deposition and gravitational settling.

Particulate concentations at 5 km from the construction activity range from a high at Beryl, Utah, of nearly 3,000 $\mu g/m^3$ (with 100 acres of unmitigated construction activity) to a low at approximately 340 $\mu g/m^3$ at Dalhart, Texas (with 60 acres of mitigated construction activity). These values are extremely high, but are still somewhat low in comparison to natural dust storms which can result in average concentration of 5,000 to 30,000$\mu g/m^3$ (Hagen and Woodruff, 1973). The OSHA standard for worker exposure is 5,000$\mu g/m^3$ of respirable dust particles and 15,000$\mu g/m^3$ for total dust (29 CFR 1910.1000). These concentrations are hourly averages predicted to occur only during the worst daily weather observations recorded during the data collecting period. Pollutant differences between sites only reflect the effect of site variation in wind speed and direction, mixing height, and stability class on pollutant dispersion. Site variations in soil silt content and humidity will affect emission rates and resulting concentrations and were not taken into account in the emission calculations because the construction activity emission factor does not have correction factors.

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*The factor used here is 1.8 tons of particulates per acre of construction per month of activity, rather than the 1.2 tons of particulates suggested since the conditions that applied to the given rate (level of activity and climate) were not conservative enough.

Table 5.4-1. Particle-size distribution, gravitational setting velocities and surface reflection coefficients for particulate emissions used in the ISC modeling of fugitive dust from OB construction activity.

Particle Size Category (μm)	Mass Mean Diameter (μm)	Mass Fraction	Settling Velocity (m/sec)	Reflection Coefficient[1]
0-10	6.30	0.14	0.001	1.00
10-20	15.54	0.55	0.007	0.82
20-30	25.33	0.31	0.019	0.72

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[1] 1.00 indicates total reflection of particles at the surface.

Source: Values presented here and used in model calculations represent ore pile and conveyor belt particulate emissions data as described in the "Industrial Source Complex Dispersion Model (ISC) User's Guide, Volume I, 1979."

Table 5.4-2. Weather station data used in meteorological input conditions for ISC modeling.

Weather Station	Applicable OB Site	Observation[1]	Mixing Height (meters)	Windspeed (m/sec)	Stability Class
Amarillo, Texas	Dalhart, Texas	Worst 1-day observation	100	3.6	E
		Worst 5-day observation	539	5.1	E
Ely, Nevada	Ely, Nevada	Worst 1-day observation	116	3.3	E
		Worst 5-day observation	277	2.3	E
Albuquerque, New Mexico	Clovis, New Mexico	Worst 1-day observation	273	1.4	E
		Worst 5-day observation	421	1.9	E
Las Vegas, Nevada	Coyote Spring, Nev.	Worst 1-day observation	102	1.9	E
		Worst 5-day observation	252	2.0	E
Salt Lake City, Utah	Delta, Utah	Worst 1-day observation	163	0.5	E
		Worst 5-day observation	209	2.5	E

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[1]From observations recorded during 1960-64, as used in "Meteorological Episodes of Slowest Dilution in the Contiguous U.S.", G. Holzworth, February 1974.

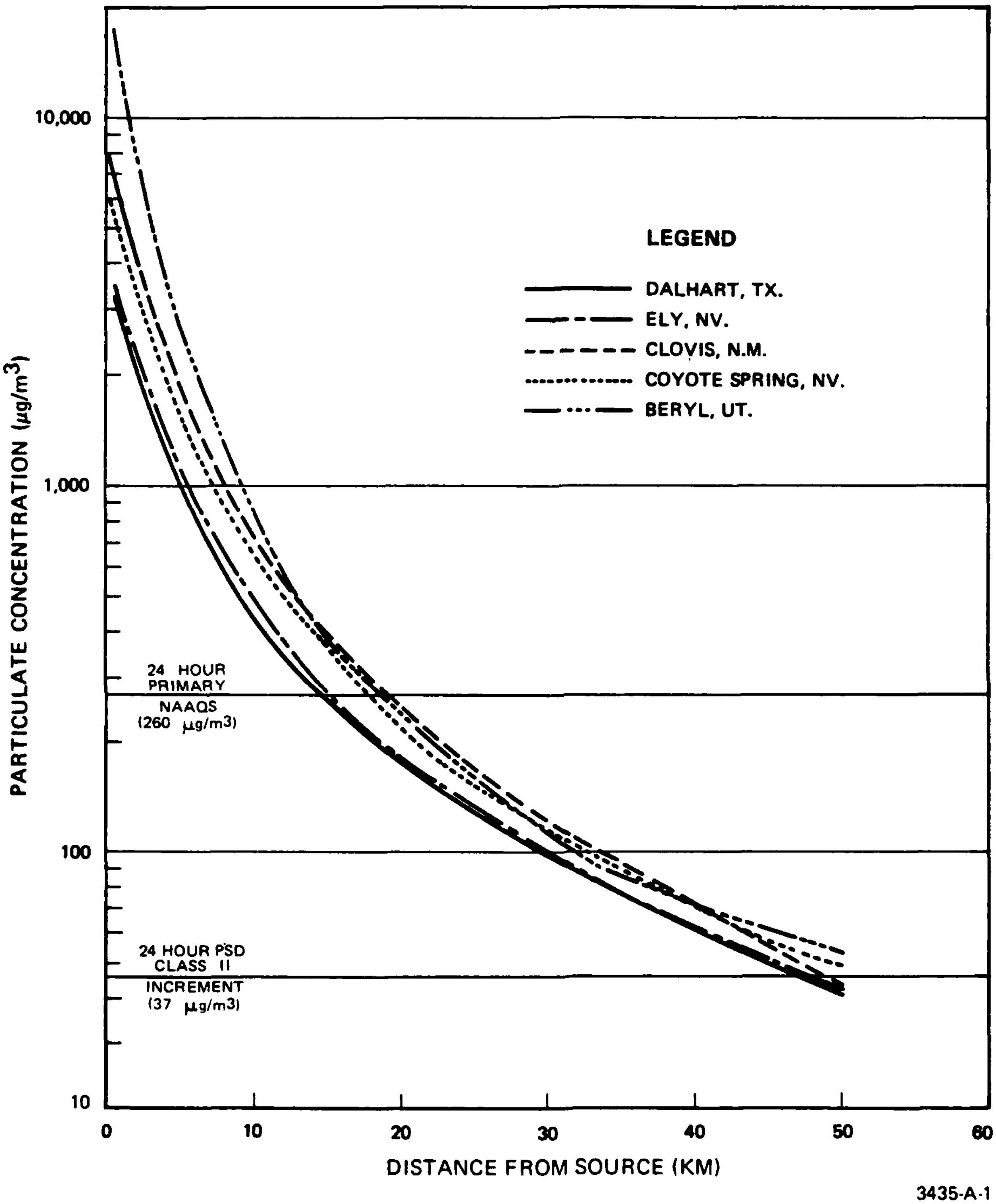

Figure 5.4-1. Predicted hourly particulate concentrations using the ISC model: 100 acres of construction activity with unmitigated emissions (40 km = 25 mi).

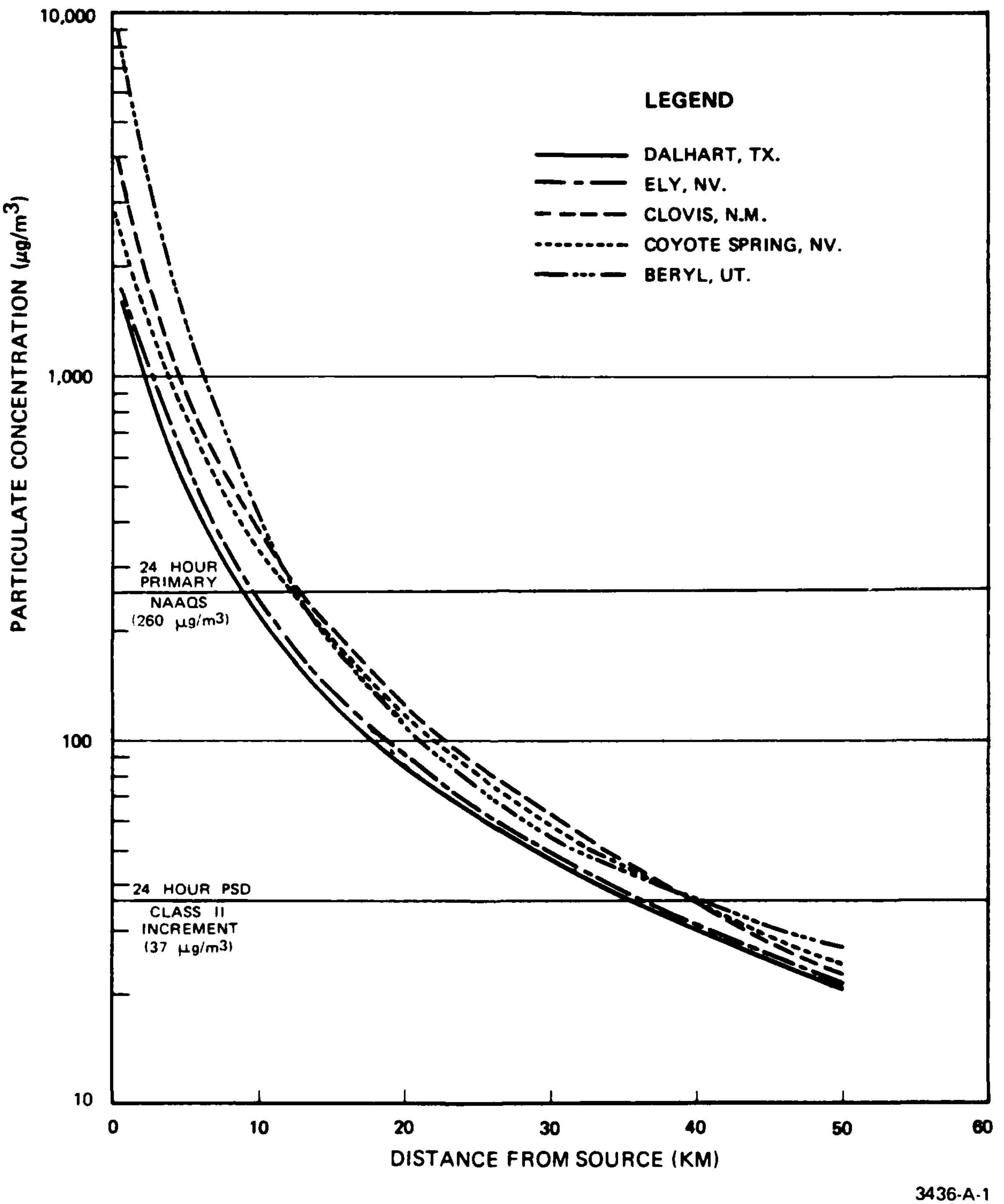

Figure 5.4-2. Predicted hourly particulate concentrations using the ISC model: 100 acres of construction activity with mitigated emissions (40 km = 25 mi).

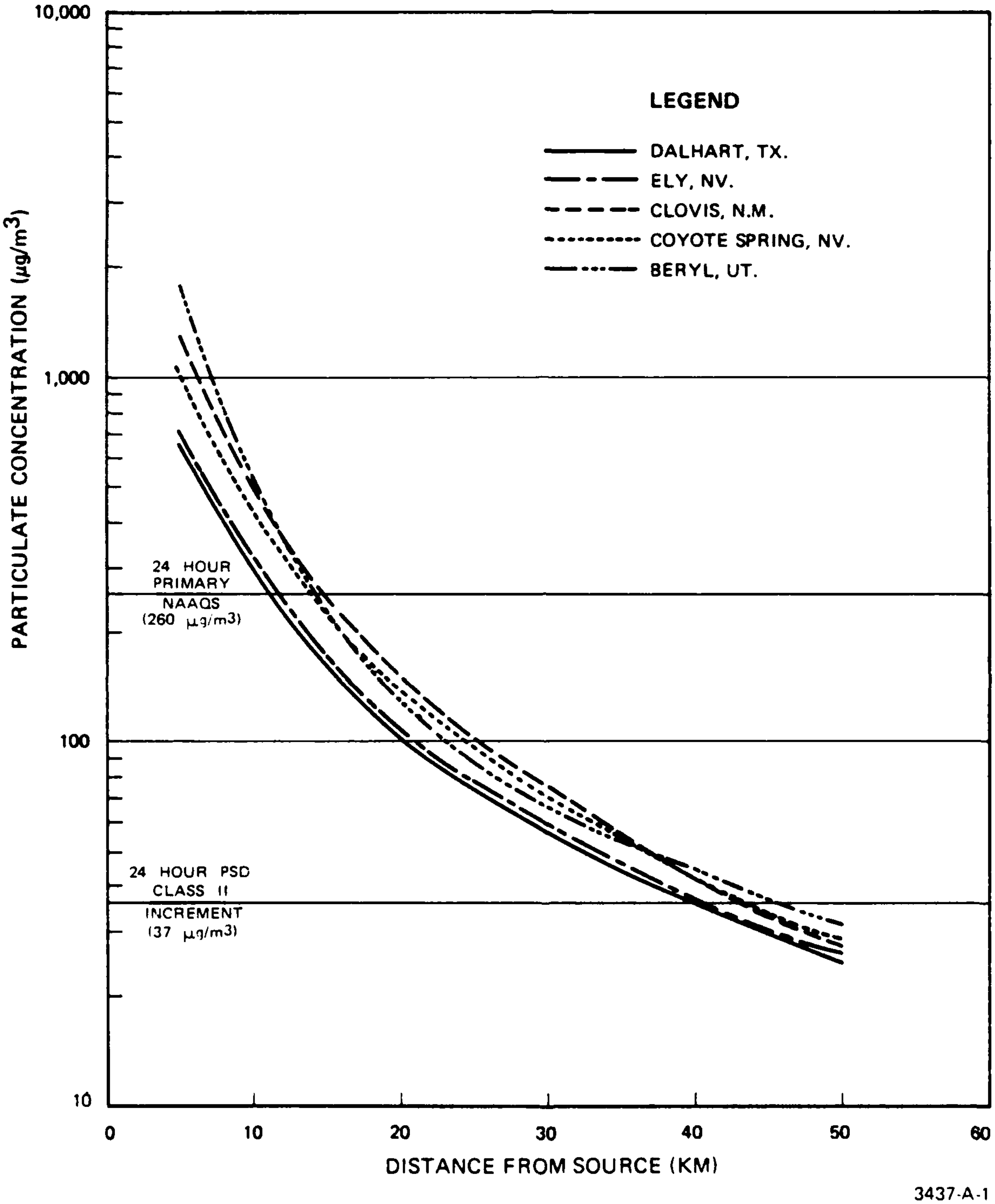

Figure 5.4-3. Predicted hourly particulate concentrations using the ISC model: 60 acres of construction activity with unmitigated emissions (40 km = 25 mi).

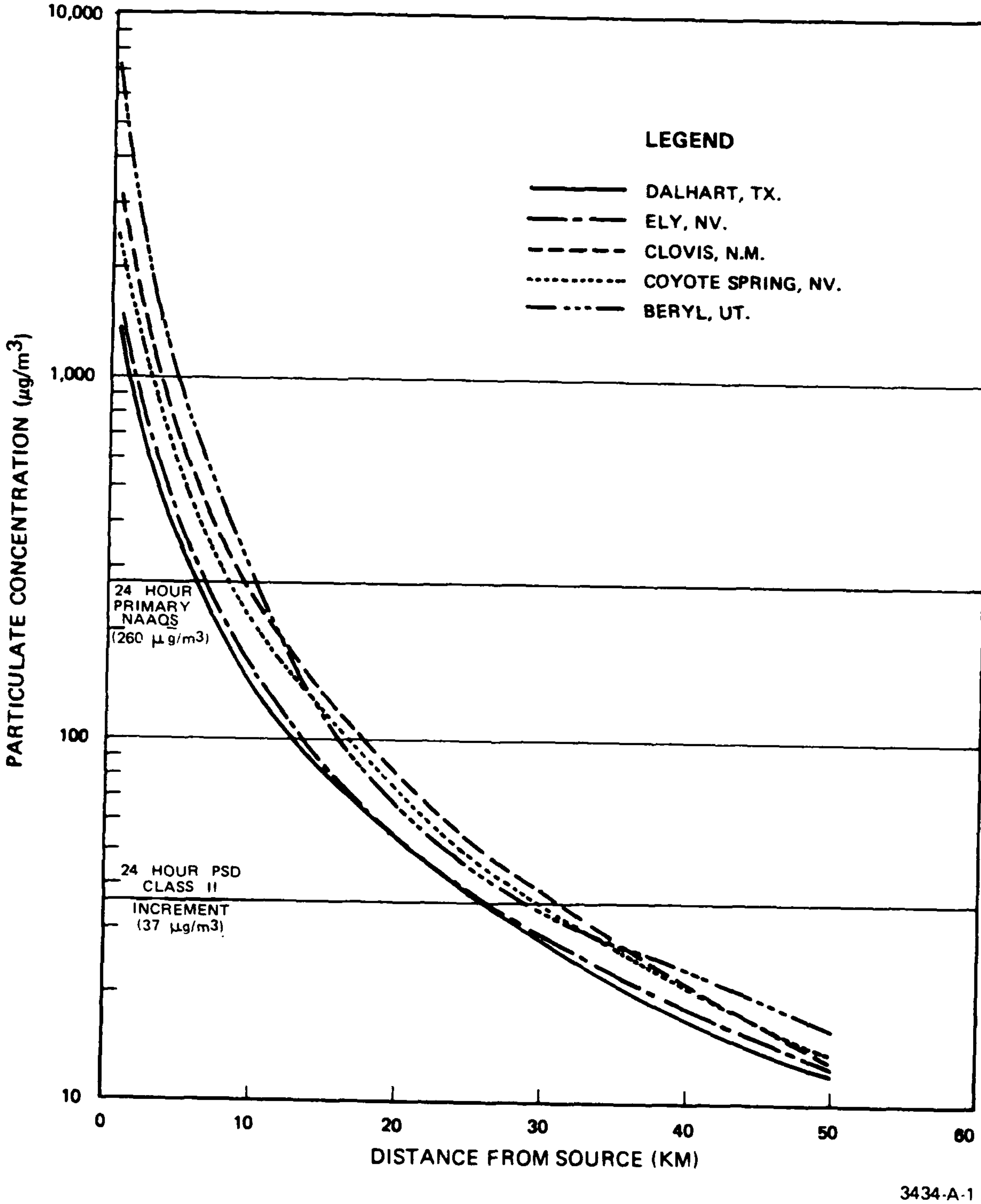

Figure 5.4-4. Predicted hourly particulate concentrations using the ISC model: 60 acres of construction activity with mitigated emissions (40 km = 25 mi).

5.5 WIND EROSION IMPACTS DURING OPERATION

The major impact on air quality in the DDA valleys during operation will be due to wind erosion emissions from disturbed surfaces. These emissions will increase ambient concentrations of TSP. It is possible that increased levels of TSP could constrain the siting of new major emission sources, such as mining operations, in the vicinity of the M-X system. This could occur if the ambient background TSP concentration is increased to a level near enough to the federal standard for TSP, that a new source would cause a violation of the standard.

To evaluate this issue and to estimate the long-term effects of system operation in the DDAs, an air quality modeling effort was carried out. The Industrial Source Complex Long Term (ISCLT) model was applied to the wind erosion emissions in an example DDA valley, Pine Valley in Utah. Pine Valley was chosen as being a representative DDA valley, with a densely packed configuration of shelters. The ISCLT model can produce monthly, seasonal, or annual averages of concentration estimates.

The wind erosion emissions input to the model were derived from the calculations described in Section 4.1.2.1.5. The wind erosion emissions calculated consist only of "suspended" particles. It was assumed that only particles less than 30 microns in diameter can be considered as suspendible. The emissions from Pine Valley were assigned to an emission source grid made up of 24 area sources, of a dimension of 5 km by 5 km. The emission for each grid square was calculated based on the total number of shelters, miles of cluster roads, and miles of DTN roads within the boundaries of each square.

Numerous model runs were made to account for the impacts under various input assumptions. Both a worst-case and a best-case wind erosion emission rate was used based on worst-case and best-case soil and climatic conditions in the Nevada/Utah region (see Section 4.1.2.1.5). Half of the model runs were made assuming that no settling and removal of particles occur and the other half assuming a settling and removal of particles based on the particle size distribution contained in Table 5.4-1. Various percentages of emission mitigation were assumed. The meteorological data used as input to ISCLT consisted of an annual relative frequency distribution of wind speed class, wind direction class, and stability class for Milford, Utah. The data (STAR data) was prepared at the National Climatic Center and represents an annual average of conditions for a period of record of 3 & 1/2 years.

The results of the ISCLT model runs are summarized in Table 5.5-1. It is apparent that there is an extremely large variation in impacts depending on the input assumptions. Assuming no settling and the worst case soil and climate (Runs 1 through 4) it is evident that the annual TSP standard will be exceeded if there is less than 50 percent migitation of emissions. If settling and removal is assumed, (Runs 5 through 8, 13 through 16) the maximum impacts are considerably lower. However, model run 5, which is for an unmitigated worst case emission, has a maximum impact that is more than 50 percent of the standard. Impacts of the best case emissions (Runs 9 through 16) are all quite low.

Additional modeling of the impacts of wind erosion on air quality was performed with the PAL model (PAL described in Section 3.3). The purpose of this

Table 5.5-1. Maximum annual TSP impacts from wind erosion in Pine Valley during operation.

Model Run	Soil and Climate Assumption[1]	Gravitational Settling and Removal of Particles[2]	Amount of Emissions Mitigation[3] (Percent)	Maximum Annual TSP Concentration (ug/m^3)
1	Worst case	No	0	160.0
2	Worst case	No	20%	128.0
3	Worst case	No	50%	80.0
4	Worst case	No	80%	32.0
5	Worst case	Yes	0	41.5
6	Worst case	Yes	20%	33.2
7	Worst case	Yes	50%	20.8
8	Worst case	Yes	80%	8.3
9	Best case	No	0	20.2
10	Best case	No	20%	16.2
11	Best case	No	50%	10.1
12	Best case	No	80%	4.0
13	Best case	Yes	0	5.2
14	Best case	Yes	20%	4.2
15	Best case	Yes	50%	2.6
16	Best case	Yes	80%	1.0

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[1]Worst case implies C' = 200 and I' = 235 tons/acre/year
Best case implies C' = 100 and I' = 86 tons/acre/year
(See Section 4.1.2.1.5)

[2]Assume particle characteristics appear in Table 5.4-1.

[3]Mitigations are assumed to be uniformly effective across each source grid square input to the model. No specific mitigations are assumed, but they could consist of minimizing the amount of disturbed area, revegetation, or other measures.

effort was to estimate short-term TSP concentrations as well as to establish a relationship between short-term concentrations and the distance from shelters and roads. Additionally, an effort was made to illustrate the relationship between wind speed and wind erosion emissions and the subsequent effect on air quality. The ISCLT model runs assumed that the wind erosion emissions occurred equally through entire large source grid squares. The PAL runs focused on an individual cluster segment and its impact on near-field air quality.

The cluster segment modeled appears in Figure 5.5-1. It consists of four shelters and 5.2 km of cluster roads. Meteorological conditions were assumed to be D stability and winds blowing normally to the cluster road. Three wind speed cases were used: 4 m/s, 8 m/s, and 12 m/s.

The 4 m/s wind speed case was assumed to produce the same nonmitigated emission rate as that produced by the worst-case climate and soil assumptions for the Nevada/Utah basing region (see Section 4.1.2.1.5). Emission for the 8 m/s and 12 m/s cases were calculated through the relationship of wind erosion emissions being proportional to the third power of wind speed. Thus the 8 m/s case had an emission rate that was 8 times larger than the 4 m/s case and the 12 m/s case had an emission rate that was 27 times larger than the 4 m/s case.

Results of the PAL model runs are summarized in Figure 5.5-2. These results have been converted to 24-hr averages from 1-hr averages according to the power law relationship:

$$X_{24} = X_1 \left(\frac{1 \text{ hr}}{24 \text{ hr}} \right)^{0.17}$$

These results indicate that downwind maximum concentrations fall off rapidly with distance from the nearest shelter. Maximum concentrations increase substantially with increasing wind speeds. This is to be expected as pollutant concentration is inversely proportional with the first power of wind speed whereas wind erosion emissions are directly proportional to the third power of wind speed. The 24-hour federal standard for TSP is exceeded for the 12 m/s and 8 m/s cases, but is not exceeded beyond 1 km downwind for the 8 m/s case or beyond 2 km downwind for the 12 m/s case. Beyond 10 km downwind there is not a substantial impact; however, this analysis does not take into account cumulative impacts of other cluster segments. Overall, the actual impacts should be less, especially at greater distances from the source, because of the lack of settling and removal of particles in the PAL model.

The wind erosion modeling done with ISCLT and PAL indicate that TSP concentrations are very dependent on soil and climate type as these parameters will affect the emission rate. Annual impacts could be significant in some valleys with unfavorable climates or soil types. Mitigation measures proposed for control of wind erosion (Section 5.6) will greatly reduce their impacts. The potential for wind erosion emissions constraining the siting of other projects in the DDAs will also be site-specific and will depend on the above-mentioned factors as well as the proximity of the new projects to M-X system elements. It is conceivable that if a siting conflict did arise, that the M-X system elements most affecting the potential new source could undergo an intensified mitigation program to reduce wind erosion emissions. Better data on site-specific soil, climate, and particulate size distribution can allow more precise prediction on a site-specific basis. This analysis could reveal the extent of mitigations required on a site-specific basis as well.

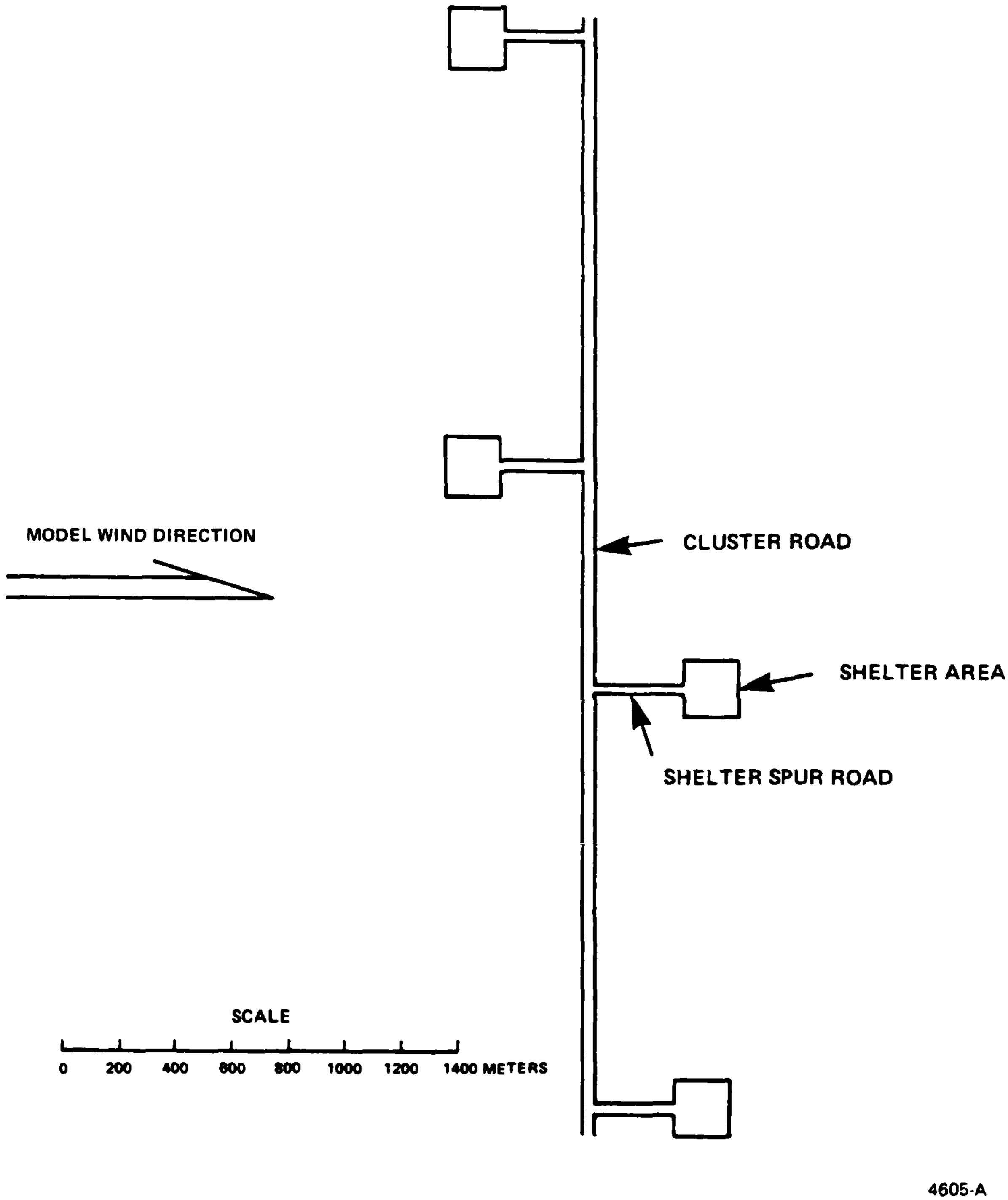

Figure 5.5-1. Cluster segment used in PAL modeling of wind erosion emissions.

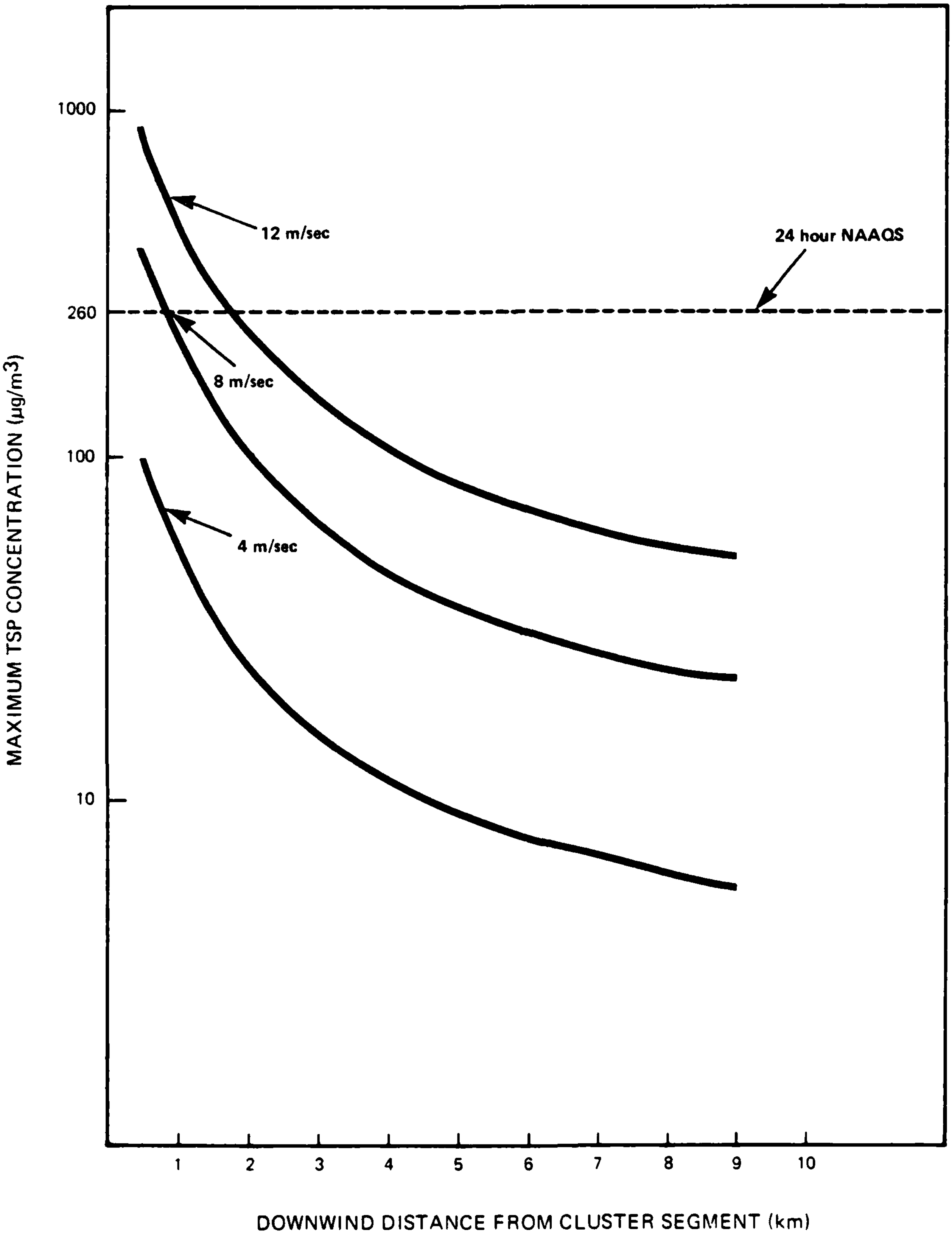

Figure 5.5-2. Maximum 24-hour TSP concentration downwind of cluster segment (Figure 5.5-2) using PAL model.

5.6 MITIGATIONS

Air quality impacts resulting from the M-X system will occur both during the construction and the operating phases. The primary pollutant emission during construction is particulate matter. The major sources for this pollutant are fugitive dust emissions from construction activities, vehicle travel over unpaved roads, and wind erosion from disturbed surfaces. An additional significant source of particulate matter occurs at the asphaltic concrete plants. Emissions of NO_x, CO, TSP, and SO_x will be released from construction vehicles as well as from construction workers' vehicles used commuting to and from the work sites. A large source of NO_x will be the generators which provide power to concrete batching plants in the deployment valleys.

During system operation, the major air quality impact will result from wind erosion of soils from disturbed surfaces. Additional particulate matter and gaseous pollutants will occur due to vehicle travel over DTN and cluster roads. At the operating bases, air quality impacts will result primarily due to emissions from vehicle traffic, and various residential emissions at the base community.

AIR FORCE PROGRAMS (5.6.1)

The Air Force will implement a program of air quality monitoring in the deployment areas during construction and operation. The monitoring program will include measurements of both particulate and gaseous pollutants. The purpose of this program is to identify potential air quality problems, monitor the effectiveness of mitigation measures and identify where the need exists for additional mitigation of emissions.

Air quality will be managed primarily through implementation of a dust control program and an emissions control program. The dust control program will include procedures to monitor air quality throughout the construction of the system. This will ensure compliance with the overall program and identify areas where excessive dust levels may occur.

Most fugitive dust will be caused by vehicles and equipment or by wind action on exposed surfaces. The program will establish design policy and designate construction procedures that minimize surface disturbance and provide control of erosion. Construction traffic will stay on road surfaces, and off-road construction travel will be subject to restrictions. Dust palliatives will be applied to roads to minimize dust generated by moving vehicles. The DTN will be paved as early in the project life as practicable in order to reduce fugitive dust and water requirements for dust control. Dust control equipment will be provided on vehicles and stationary sources. Aggregate storage areas and areas experiencing construction activity will be designed to minimize dust. Respiratory protection devices will be provided for workers when required.

In order to prevent temporarily disturbed areas from becoming long-term sources of dust, a revegetation program will be established. The revegetation program is discussed in Section 2.3. The emissions control program will ensure that emission levels are controlled so that compliance with federal, state, and local air quality standards is maintained.

Emissions will be minimized by designing the operating base for both reduced vehicle travel and the use of nonmotor-vehicle transportation. Nonpolluting energy sources will be utilized where feasible. Bus systems will be established both for construction personnel and operating base personnel to travel within the base itself and to communities.

Emission control equipment will be provided and an inspection and maintenance program will be established for Air Force vehicles and equipment.

OTHER MITIGATIONS UNDER CONSIDERATION (5.6.2)

The use of palliatives for dust control on unpaved surfaces may be advantageous, since suppression with water alone is unlikely due to limited water resources in the basing region. The use of water mixed with a wetting agent (surfactant) is an effective suppressant of dust and would decrease the amount of water needed. Application of oil to road surfaces is an effective measure but one that has side effects, since it is estimated that 70 to 75 percent of the oil applied is lost due to runoff (Cooper et al., 1979). This could be damaging to local biota. Dust can also be effectively controlled through the use of chemical stabilizers which serve to isolate road surfaces from wind and vehicle entrainment of dust by promoting the formation of a protective crust with the road dirt. The effectiveness of the above-mentioned mitigations is variable and depends on the implementation method as well as numerous other factors such as soil type, slope, vehicle size, and traffic density. However, the reduction in dust quantity is initially around 50 percent for most palliative measures.

An innovative approach in the control of dust generation from unpaved roads is the use of road carpets to stabilize the dust surface. Road carpets consist of a fabric laid over the soil to contain the overburden aggregate, while allowing newly deposited fine particles to pass through the fabric (Blackwood, 1979). Thus, these particles are not reentrained into the air. Field tests of road carpets indicate a control efficiency ranging from 30 to 70 percent.

In addition to road dust, emissions of particulate matter due to construction activity and wind erosion from aggregate piles can be mitigated by use of water and palliatives. The utilization would be controlled by the magnitude of the activity and the total availability of water. The judicious use of innovative technologies such as the wind fence and charged particle fogger for controlling aggregate pile emissions could result in substantial savings of water.

The establishment and enforcement of speed limits can effectively control dust as it has been shown that in the 30 mph to 50 mph range, emissions are directly proportional to vehicle speed (U.S. EPA, 1977). Vehicle miles traveled will be minimized during construction through the restriction of off-road travel as well as the use of mass transportation for commuting workers. The reduction of vehicle miles traveled will also reduce gaseous emissions of NO_x, HC, CO, and SO_x. The periodic inspection and maintenance required for all Air Force vehicles also provides emissions control of a considerable degree.

A primary measure to control wind erosion is the revegetation of disturbed surfaces. The effectiveness and the extent of the revegetation will depend to a large degree on the amount of water available for revegetation. Under

a comprehensive revegetation program using water whenever and wherever needed, recovery in the Nevada/Utah area could take 5 to 10 years. Recovery in Texas/New Mexico under the same program becomes more effective towards reducing emissions in the succeeding years after the program is initiated. As a consequence, there will be a certain period of time in which the wind erosion emissions will be unmitigated. The use of palliatives, surface binders, or various mulches are methods that can help fill this gap.

Any power production capabilities at the operating base will be required to meet applicable federal, state, and local emissions standards. For this reason, no impact on air quality would be expected under normal conditions. Provisions for shutdown, if control or other equipment malfunctions occur, are contained in operating guidelines, and should limit impacts, if any, to brief periods of abnormal operation associated with shutdown. Mitigation would involve sufficient routine system maintenance to prevent equipment failure or the substitution, where possible, of renewable energy sources.

6.0 IMPACT SIGNIFICANCE ANALYSIS

DESCRIPTION OF METHODOLOGY

Air quality impacts were assessed using air quality models that predict pollutant concentrations as a function of meteorological and emissions data that are input into the model. The Point-Area-Line (PAL), ISC and IMPACT models were used to predict particulate concentrations due to fugitive dust emissions from construction activity and wind erosion. The HIWAY model was run to predict gaseous pollutant levels due to vehicular emissions in the construction area and at the operating base during operations. The IMPACT model was also used to predict regional CO and NO_x levels in the operating base vicinity and community due to vehicles and space heating and cooling emissions. It was determined from the modeling results that certain primary disturbances, or M-X associated activities, would result in significant air quality impacts. Significant primary disturbances considered for the short term were the following: operation of construction support facilities (NO_x), operation of construction support facilities (particulates), construction of clusters and protective structures (particulate matter), and construction of the primary or secondary operating base (particulate matter). The following primary disturbances were considered to be significant for the long term: operation of the system (particulate matter) and operation of the primary or secondary operating base (particulate matter and CO).

The severity of impact in a given hydrographic basin depends on the level and type of M-X activity (or primary disturbance) in a basin, as well as any air quality-related features of the basin such as proposed or existing air pollutant sources and its geographic relation to any nonattainment areas, Class I areas, or other sensitive receptors.

Valleys and counties were assigned a normalized impact number from 0 to 5 based on the degree of potential for significant air quality impact due to the presence of one or more primary disturbance source (support facility, OB, or construction activity). Construction activity was weighted as "high," "medium," or "low" according to a calculated "system density." System density is equal to the number of protective shelters in a valley or county divided by the area of the valley/county. High, medium, and low level cutoff points were determined by natural breaks in grouping of the values.

Another normalized number from 0 to 5 was assigned to each valley or county dependent upon the proximity of other air quality-related influencing factors. The air quality-related features of the hydrographic basins of the deployment area for the Proposed Action and Alternatives 1 through 6 are shown in Table 6-1. The air quality characteristics by county for Alternatives 7 and 8 are found in Table 6.8-1.

The two normalized numbers were averaged and an impact rating asigned according to the scale: 0 = no impact; 1 = low impact; 2 and 3 = medium impact; and, 4 and 5 = high impact.

It was not possible to determine if additional combustion-related air pollutants such as SO_x may cause significant air quality impacts at the operating base during operations since sufficient data were not available on the electrical energy source

Table 6-1. Summary of air quality resource characteristics for each hydrologic subunit for the deployment areas of the Proposed Action and the Alternatives 1-6 (Page 1 of 4).

Hydrologic Subunit No.	Name	Proposed Sources	Nonattainment Areas	Class I Areas	Sensitive Receptors
(4)	Snake	--	None[1]	None	Within 100 mi of Lehman Caves
(5)	Pine	Pine Grove molybdenum	None	Within 100 mi of Zion and Bryce Canyon	Within 30 mi of Lehman Caves
(6)	White	--	None	None	Within 30 mi of Lehman Caves
(7)	Fish Springs	--	None[1]	None	--
(8)	Dugway	--	None[1]	None[1]	--
(9)	Government Creek	--	None[1]	None	--
(46)	Sevier Desert	IPP Power Plant, modular home factory, cement plant	None	Within 100 mi of Zion and Bryce Canyon	Town of Delta nearby
(46A)	Sevier Desert-Dry Lake	--	None	Within 100 mi of Zion and Bryce Canyon	Within 100 mi of Cedar Breaks
(50)	Milford	Molybedenum Mine, geo-thermal plant	None	Within 40 mi of Zion and Bryce Canyon	Within 40 mi of Cedar Breaks
(54)	Wah Wah	--	None	None	Within 100 mi of Death Valley
(137A)	Big-Smoky-Tonapah Flat	Anaconda molybdenum mine	Near Gabbs	None	Within 100 mi of Death Valley
(139)	Kobeh	--	None	None	--

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Table 6-1. Summary of air quality resource characteristics for each hydrologic subunit for the deployment areas of the Proposed Action and the Alternatives 1-6 (Page 2 of 4).

Hydrologic Subunit No.	Name	Proposed Sources	Nonattainment Areas	Class I Areas	Sensitive Receptors
(140A)	Monitor Northern	--	None	None	--
(140B)	Monitor Southern	--	None	None	--
(141)	Ralston	Anaconda	None	None	Within 100 mi of Death Valley
(142)	Alkali Springs	Anaconda	None	None	Within 100 mi of Death Valley
(148)	Cactus Flat	--	None	None	Within 100 mi of Death Valley
(149)	Stony Cabin	--	None	None	Within 100 mi of Death Valley
(1510	Antelope	--	None	None	--
(154)	Newark	--	None	None	--
(154A)	Northern Little Smoky	--	None	None	--
(155C)	Southern Little Smoky	--	None	None	--
(156)	Hot Creek	--	None	None	Within 100 mi of Death Valley
(170)	Penoyer	--	None	None	Within 100 mi of Death Valley
(171)	Coal	--	None	None	Within 100 mi of Death Valley
(172)	Garden	--	None	None	Within 100 mi of Death Valley
(173A)	Southern Railroad	-- --	None None	None None	Within 100 mi of Death Valley

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Table 6-1. Summary of air quality resource characteristics for each hydrologic subunit for the deployment areas of the Proposed Action and the Alternatives 1-6 (Page 3 of 4).

Hydrologic Subunit No.	Hydrologic Subunit Name	Proposed Sources	Nonattainment Areas	Class I Areas	Sensitive Receptors
(173B)	Northern Railroad	--	None	None	Duckwater Indian Reservation
(174)	Jakes	--	Adjacent to Steptoe Valley[3]	None None	-- --
(175)	Long	--	Adjacent to Steptoe Valley[3]	None	--
(178B)	South Butte	--	Adjacent to Steptoe Valley[3]	None	-- None
(179)	Steptoe[4]	McGill smelter, Kennecott Copper Mine	Entire valey (SO_2) (considered for (TSP)	None None	City of Ely
(180)	Cave	--	Adjacent to Steptoe Valley[3]	None None	-- --
(181)	Dry Lake	--	Near Steptoe Valley[3]	Within 100 mi of Zion	Within 100 mi of Cedar Brooks
(182)	Delmar	--	None	Within 100 mi of Zion	Within 100 mi of Cedar Brooks
(183)	Lake	--	Adjacent to Steptoe Valley[3]	Within 100 mi of Zion	Within 100 mi of Cedar Brooks
(184)	Spring	--	Adjacent to Steptoe Valley[3]	Within 100 mi of Zion	Within 10 mi of Lehman Caves
(196)	Hamlin	--	Near to Steptoe Valley[3]	Within 100 mi of Zion	Within 10 mi of Lehman Caves
(202)	Patterson	--	None	Within 100 mi of Zion	Within 100 mi of Cedar Brooks

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Table 6-1. Summary of air quality resource characteristics for each hydrologic subunit for the deployment areas of the Proposed Action and the Alternatives 1-6 (Page 4 of 4).

Hydrologic Subunit No.	Hydrologic Subunit Name	Proposed Sources	Nonattainment Areas	Class I Areas	Sensitive Receptors
(207)	White River	--	Adjacent to Steptoe Valley[3]	None None	-- --
(208)	Pahroc	--	None	None	--
(209)	Pahranagat	--	None	Within 100 mi of Zion	Within 100 mi of Death Valley
(210)	Coyote Spring	Near to proposed Harry Allen Power Plant	Adjacent to Las Vegas (03, TSP, and CO)	Within 100 mi of Zion	--
(53)	Beryl	--	None	Within 100 mi of Zion	Within 100 mi of Cedar Brooks

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[1]Nearby Tooele County is nonattainment for SO_2, which is not a significant M-X pollutant.

[2]Nearby Cedar City is nonattainment for SO_2, which is not a significant M-X pollutant.

[3]Steptoe Valley is nonattainment for SO_2 and being considered as nonattainment for TSP.

for the operating base. Also, sufficient data were not available on the magnitude, type, and extent of operating base HC and NO_x emissions to determine if any oxidant problem would occur at any of the proposed or alternative operating base sites. Further, NO_x emissions from the power generators used at the construction camp may cause severe elevated NO_x levels to occur in the camp and vicinity, however, data concerning the generators were not sufficient to quantify the severity of the impact.

6.1 PROPOSED ACTION

The level of impact on air quality during the short- and long-term was assessed as being either none, low, moderate, or a high impact. A table summarizing the short- and long-term impacts by hydrographic basin for the DDA of the Proposed Action and Alternatives 1-6 is presented in Table 6.1-1. This table should only be viewed as showing the relative impacts between hydrologic basin. None of the air quality impacts can be considered as irreversible. Existing air quality in the Nevada/Utah area is generally considered excellent with the exception of specifically identified areas such as the Steptoe, Las Vegas, and the Gabbs Valley unclassified areas. Due to a copper smelter northeast of Ely, the Steptoe Valley has been identified by EPA as a nonattainment area for SO_2 and is being considered for redesignation to nonattainment status for TSP. The deployment area is characterized by complex terrain features. Locally poor dispersion conditions frequently occur during evening and early morning hours due to low inversion levels. The meteorological and terrain conditions tend to localize and increase air quality impacts for the periods when such conditions occur.

Significant air quality impacts will occur due to particulate emissions from M-X construction activity in Nevada/Utah. Under modeled conditions within the valleys, increased 24-hour particulate levels could occur as high as 90 $\mu g/m^3$ averaged over a 4 km square grid cell (the cell size used for modeling) due to construction of the DTN, cluster roads, and protective structures. This is compared to the federal standard of 260 $\mu g/m^3$. Even greater particulate level increases that exceed state and federal air quality standards will result in localized construction areas. Therefore, basins with very dense M-X system activities were designated high impact in the short-term due to predicted elevated dust levels. Related effects generally are short-term visibility impacts. Long-range transport effects could extend short-term visibility impacts to the scenic vistas of Cedar Breaks National Park, Zion National Park, Bryce Canyon, Lake Mead National Recreation Area, Great Basin National Park (proposed), or the Lehman Caves National Monument Area. This is reflected in the analysis by impact significance levels of moderate to high impact in M-X basins within 40 to 100 mi of designated scenic areas. Temporarily increased dust levels will also occur at Duckwater Indian Reservation under certain wind and stability conditions. In addition, these areas would be potentially affected by increased dust from disturbed and exposed soil surfaces remaining after construction. Distribution of zeolites in the Great Basin soils is discussed under Mining and Geology (see Mining and Geology Technical Report). Health effects of inhaled fugitive dust, including zeolites, is discussed in the Public Health Concerns Technical Report, ETR-43.

It is difficult to quantify air quality constraints which may be imposed on future development opportunities as a result of M-X-induced effects. The most

Table 6.1-1. Potential direct impact to air quality in the Nevada/Utah DDA for Alternatives 1-6.

Hydrologic Subunit or County No.	Name	Short Term Impacts[1]	Long Term Impacts[1]
	Subunits or Counties with M-X Clusters and DTN		
4	Snake, Nev./Utah	***	*
5	Pine, Utah	***	***
6	White, Utah	***	*
7	Fish Springs, Utah	***	***
8	Dugway, Utah	***	*
9	Government Creek, Utah	***	*
46	Sevier Desert, Utah[2]	***	*
46A	Sevier Desert-Dry Lake, Utah[2]	***	*
54	Wah Wah, Utah	*****	***
137A	Big Smoky-Tonopah Flat, Nev.	***	*
139	Kobeh, Nev.	***	***
140A	Monitor-North, Nev.	***	*
140B	Monitor-South, Nev.	***	*
141	Ralston, Nev.	*****	***
142	Alkali Spring, Nev.	*****	***
148	Cactus Flat, Nev.	*	-
149	Stone Cabin, Nev.	***	*
151	Antelope, Nev.	*****	***
154	Newark, Nev.	***	*
155A	Little Smoky-North, Nev.	***	*
155C	Little Smoky-South, Nev.	***	*
156	Hot Creek, Nev.	***	***
170	Penoyer, Nev.	*****	***
171	Coal, Nev.	*****	***
172	Garden, Nev.	*****	***
173A	Railroad-South, Nev.	***	*
173B	Railroad-North, Nev.	***	*
174	Jakes, Nev.	*****	***
175	Long, Nev.	***	*
178B	Butte-South, Nev.	***	*
179	Steptoe, Nev.	*	-
180	Cave, Nev.	***	***
181	Dry Lake, Nev.[2]	*****	***
182	Delamar, Nev.	***	***
183	Lake, Nev.	*****	***
184	Spring, Nev.	***	*
196	Hamlin, Nev./Utah	*****	***
202	Patterson, Nev.	***	*
207	White River, Nev.	***	*
208	Pahroc, Nev.	*	-
209	Pahranagat, Nev.	***	*
	Overall DDA	*****	***

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[1] - = No impact.
* = Low impact (a basin with a low level of construction activity, no major pollutant sources, no construction camp, and not within a significant distance of Class I or nonattainment areas).
*** = Moderate impact (a moderate level of construction activity, or pollutant sources within a significant distance of Class I or nonattainment areas).
***** = High impact (a high level of construction activity, and/or a construction camp within a significant distance of Class I nonattainment areas, or major pollutant sources).

significant area of potential constraint is the depletion of allowable PSD increment, but for this issue, not only is it difficult to quantify the extent of depletion, it is also unclear as to whether or not the federal regulations apply. As written in the Federal Register, the PSD increments are consumed in general as a result of emissions from new major stationary sources or modifications to such sources. The great majority M-X-related emissions are not from stationary sources but from area sources such as disturbed land surfaces and increased vehicular traffic over unpaved roads.

The overall effect of increased wind erosion from new roads, built during system construction, and other exposed surfaces not revegetated could elevate ambient TSP concentrations to such a level as to force new sources of TSP to use extremely effective emission control technology in avoiding violation of NAAQS for TSP.

The level of impact assigned to the hydrographic basins with operating bases is given in Table 6.1-2. The hydrographic basins with operating bases were considered high impact areas during the short-term due to the high level of construction activity, causing elevated particulate levels. During the long-term, elevated CO and particulate levels will cause moderate impact in the operating base vicinity.

MILFORD OPERATING BASE SITE

The Milford operating base is in hydrologic subunit 50. The base is within 100 mi of Zion and Bryce Canyon Class I areas. Also, the Milford OB airfield is approximately 40 mi from the Cedar Breaks proposed Class I area. Elevated particulate levels due to fugitive dust caused by construction of the operating base or increased SO_x, NO_x, or oxidant levels during operation of the operating base may affect visibility at these Class I areas. However, sufficient data is not available concerning construction and operation of the operating base in order to determine if these possible impacts will be significant. Operation base community vehicular traffic will cause elevated CO concentrations to occur in the immediate vicinity of the operating base and the support community.

COYOTE SPRING OPERATING BASE SITE

There are no Class I areas within 100 mi of the Coyote Spring operating base site located in hydrologic subunit 210. It is within 20 mi of an existing power plant, the Reid Gardner Plant, and a proposed power plant, the Harry Allen Plant. Since the energy source for the operating base is uncertain, the potential cumulative air quality impact of these two power plants and the Coyote Spring OB site is unknown. However, the worst-case assumption is the use of a coal-fired central cooling and heating facility with a heat input of about 300 million Btu per hour. This facility would produce far less emissions than the Reid Gardner and Harry Allen plants, which are each at least on an order of magnitude larger in heat input. The Coyote Spring hydrologic subunit is adjacent to Las Vegas Valley, which is designated as a nonattainment area for TSP, O_3, and CO. During construction of the operating base, fugitive dust from construction may aggravate the particulate problem in Las Vegas Valley. During operation, CO, HC, NO_x, and O_3 will increase at the operating base site and also, to some degree, at Las Vegas Valley due to the population growth as a result of the M-X system.

Table 6.1-2. Potential overall impact to air quality resulting from construction and operation of M-X operating bases for the Proposed Action and Alternatives 1-8.

Estimated Short Term Overall Impact[1]

Hydrologic Subunit No.	Hydrologic Subunit Name	Proposed Action Coyote Spring/ Milford	Alt. 1 Coyote Spring/ Beryl	Alt. 2 Coyote Spring/ Delta	Alt. 3 Beryl/ Ely	Alt. 4 Beryl/ Coyote Spring	Alt. 5 Milford/ Ely	Alt. 6 Milford/ Coyote Spring	Alt. 8 Coyote Spring/ Clovis
	Subunits within OB Suitability Zone								
46	Sevier Desert, Utah	-	-	*****	-	-	-	-	-
46A	Sevier Desert-Dry Lake, Utah	-	-	***	-	-	-	-	-
50	Milford, Utah	*****	-	-	-	-	*****	*****	-
52	Lund District, Utah	***	***	-	***	***	***	***	-
53	Beryl-Enterprise, Utah	-	*****	-	*****	*****	-	-	-
179	Steptoe, Nev.	-	-	-	*****	-	*****	-	-
210	Coyote Spring, Nev.	*****	*****	*****	-	*****	-	*****	*****
219	Muddy River Springs, Nev.	***	***	***	-	***	-	***	***
	Overall OB Impact	*****	*****	*****	*****	*****	*****	*****	*****

Estimated Long Term Overall Impact[1]

Hydrologic Subunit No.	Hydrologic Subunit Name	Proposed Action Coyote Spring/ Milford	Alt. 1 Coyote Spring/ Beryl	Alt. 2 Coyote Spring/ Delta	Alt. 3 Beryl/ Ely	Alt. 4 Beryl/ Coyote Spring	Alt. 5 Milford/ Ely	Alt. 6 Milford/ Coyote Spring	Alt. 8 Coyote Spring/ Clovis
	Subunits within OB Suitability Zone								
46	Sevier Desert, Utah	-	-	***	-	-	-	-	-
46A	Sevier Desert-Dry Lake, Utah	-	-	***	-	-	-	-	-
50	Milford, Utah	*****	-	-	-	-	*****	*****	-
52	Lund District, Utah	***	***	-	***	***	***	***	-
53	Beryl-Enterprise, Utah	-	***	-	***	***	-	-	-
179	Steptoe, Nev.	-	-	-	***	-	***	-	-
210	Coyote Spring, Nev.	*****	*****	*****	-	*****	-	*****	*****
219	Muddy River Springs, Nev.	***	***	***	-	***	-	***	***
	Overall OB Impact	***	***	***	***	***	***	*****	*****

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[1] - = No impact.
* = Low impact (no pollutant sources; low level of construction; not close to a nonattainment area).
*** = Moderate impact (a basin adjacent to one containing an OB; in the long term exposed to elevated CO and particulate levels).
***** = High impact (basin contains an OB; high level of construction activity in the short term and/or a pollutant source in the long term; close to a non-attainment area or population center.

The influx of M-X-related population into the area would use a portion of allowable emissions offsets as outlined in the Las Vegas Valley Air Quality Implementation Plan. Depleting the offset allotment would make its acquisition by another project more difficult. These considerations caused the hydrographic basin with the Coyote Spring operating base to be designated high impact for the long-term.

6.2 ALTERNATIVE 1

The location of the secondary operating base is the only difference between the Proposed Action and Alternative 1. See Table 6.1-1 for the impact significance of the DDA and Table 6.1-2 for the impact significance of the primary and secondary operating base. The secondary OB site for Alternative 1 is at Beryl, Utah, located in hydrographic subunit 53, rather than in subunit 50 as in the Proposed Action. All impact significance values assigned to the remaining basins do not change because the configuration of clusters and roadways is identical under both alternatives. Impacts within hydrographic subunit 53 are significant for Alternative 1, during both short and long-term periods. Impacts in hydrographic subunit 50 changes to a no impact level for Alternative 1. The Beryl, Utah, OB site is within 100 mi of the Cedar Breaks proposed Class I area and Zion National Park, an existing Class I area. It is not near any areas designated nonattainment for pollutants significant to the M-X system impacts.

6.3 ALTERNATIVE 2

The location of the secondary operating base is the only difference between the Proposed Action and Alternative 2. See Table 6.1-1 for the impact significance of the DDA and Table 6.1-2 for the impact significance of the secondary operating base. The secondary OB site for Alternative 2 is at Delta, Utah, located in hydrographic subunit 46, rather than in subunit 50 as in the Proposed Action. All the impact significance values assigned to the remaining subunits do not change because the configuration of clusters and roadways is identical under both alternatives. For Alternative 2, hydrographic subunit 46 is ranked as high impact during the short-term period, and moderate impact during the long-term period. Hydrographic subunit 50 would have no impact. The Delta, Utah OB site is greater than 100 mi from the Cedar Breaks proposed Class I area and Zion National Park, an existing Class I area. It is not near any designated nonattainment areas for a pollutant considered significant to the M-X system. Since plans for the operating base energy source have not been finalized, the potential cumulative impact of the planned IPP power plant and the Delta OB is unknown.

6.4 ALTERNATIVE 3

The configuration of the M-X system in the deployment area is identical for Alternative 3 as for the Proposed Action. Therefore, impact significance assigned to all hydrographic subunits in the deployment area are the same for Alternative 3 as for the Proposed Action, with the exception of those subunits with the primary and secondary operating base sites. Beryl, Utah, in hydrographic subunit 53, is the location of the primary operating base site for Alternative 3. See Table 6.1-1 for the impact significance of the DDA and Table 6.1-2 for the impact significance of the operating bases. The secondary operating base site is at Ely, Nevada, located in hydrographic subunit 179. These subunitbasins are assigned high impact significance

level for the short-term period and a moderate level for the long-term period. Short-term problems concern elevated particulate levels caused by particulate emissions from construction of the operating base. CO emissions from vehicles will cause elevated CO concentrations in areas adjacent to high density vehicular traffic in the operating bases and support communities. This will be a long-term impact.

Impact significance for the Beryl, Utah, primary operating base will be nearly identical to those described under Alternative 1 for the secondary base configuration. Differences were considered to be undetectable at the level of this analysis.

6.5 ALTERNATIVE 4

The significance of air quality impacts on air resources in Nevada and Utah due to the M-X system for Alternative 4 are nearly identical to those described for Alternative 1. Differences were considered insignificant for purposes of this analysis.

6.6 ALTERNATIVE 5

The impact significance for Alternative 5 is the same for the DDA as those described in the Proposed Action. The impacts of the Milford, Utah primary operating base are nearly identical to those described for the Milford, Utah secondary operating base of the Proposed Action. The impact significance is considered identical at the level of this analysis. The impact significance for the secondary operating base at Ely, Nevada is the same as that described in Alternative 3.

6.7 ALTERNATIVE 6

The significance of M-X air quality impacts on air resources in Nevada and Utah for Alternative 6 are close to those described for the Proposed Action. Differences were considered insignificant for purposes of this analysis.

6.8 ALTERNATIVE 7

The methodology used to determine impact significance for the Texas/New Mexico region was the same as that discussed for the Nevada/Utah region (see Description of Methodology, Section 6). The county is the geographic unit considered in the Texas/New Mexico region as opposed to the hydrographic subunit used in Nevada/Utah basin and range province. For air quality purposes the county does not have any boundaries to atmospheric processes; however, the county, as a unit for analysis is useful as it is a geographic area defined by a certain density of M-X system activity, and has certain baseline environment characteristics.

Table 6.8-2 shows the level of air quality impact in counties of the DDA. The type and level of M-X system activity in the county, as well as the air quality-related characteristics of the county, were considered in assessing the level of potential impact. County-specific features taken into account are shown in Table 6.8-1.

The same air pollution-related primary disturbances were considered in the Texas/New Mexico region as for Nevada/Utah. Fugitive dust emissions will be of

Table 6.8-1. Summary of air quality characteristics by county for Alternatives 7 and 8.

County Name	Existing sources	Nonattainment Areas	Class I Areas	Sensitive Receptors
Chaves (N. Mex.)	9-TSP, 1-SO_x, 4-NO_x, 3-C0,4-HC	Adjacent to Eddy Co. (TSP)	Within 100 mi of Carlsbad, Salt Creek, and White Mountains	Near city of Roswell Bitter Lake NMR, and Salt Creek Wilderness
Curry (N. Mex.)	3-TSP	None	Within 100 mi of Salt Creek	Near City of Clovis
DeBaca (N. Mex.)	1-TSP	None	Within 100 mi of Salt Creek	--
Harding (N. Mex.)	--	None	Within 100 mi of Capulin Mountains	--
Lea (N. Mex.)	14-TSP, 11-SO_x, 11-NO_x, 1-CO, 13-HC	None	Within 100 mi of Salt Creek	--
Quay (N. Mex.)	3-TSP, 1-SO_x, 1-NO_x, 1-CO, 1-HC	None None	Within 100 mi of Capulin Mountains	Near city of Tucumcari
Roosevelt (N. Mex.)	5-TSP, 1-SO_x, 5-NO_x, 5-CO, 5-HC	None	Within 100 mi of Salt Creek	Near city of Portales and Grulla NWR
Union (N. Mex.)	1-TSP, 1-SO_x 1-NO_x, 1-CO, 1-HC	None	Within 100 mi of Capulin Mountains	Kiowa National Grass-land
Bailey (Tex.)	7-TSP, 1-CO, 1-HC	None	None	Near Muleshoe NWR
Castro (Tex.)	12-TSP, 1-NO_x, 1-CO, 1-HC	None	None	--
Cochran (Tex.)	3-TSP, 1-SO_x, 1-NO_x, 1-CO, 1-HC	None	None	--
Dallam (Tex.)	4-TSP	None	Within 100 mi of Capulin Mountains	Rita Blanca National Grassland
Deaf Smith (Tex.)	15-TSP,2-SO_x 2-NO_x, 2-CO, 2-HC	None	None	Near town of Hereford
Hartley (Tex.)	4-TSP	None	Within 100 mi of Capulin Mountains	Near town of Dalhart
Hockley (Tex.)	6-TSP, 2-SO_x, 2-NO_x, 2-CO, 3-HC	None	None	Near town of Levelland
Lamb (Tex.)	19-TSP, 2-SO_x, 2-NO_x, 2-CO, 2-HC	None	None	Near town of Littlefield
Oldham (Tex.)	5-TSP	None	None	--
Parmer (Tex.)	16-TSP, 1-NO_x, 1-CO, 1-HC	None	None	--
Randall (Tex.)	4-TSP	None	None	Near cities of Amarillo and Canyon and near Buffalo Lake NWR
Sherman (Tex.)	5-TSP	None	None	--
Swisher (Tex.)	16-TSP, 1-NO_x, 1-HC,	None	None	Near town of Tulia

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Table 6.8-2. Direct impact to air quality in the Texas/New Mexico DDA for Alternative 7.

County	Short Term Impacts[1]	Long Term Impacts[1]
Counties with M-X Clusters and DTN		
Bailey, Tex.	***	***
Castro, Tex.	*****	***
Cochran, Tex.	***	***
Dallam, Tex.	*****	***
Deaf Smith, Tex.	*****	***
Hartley, Tex.	*****	***
Hockley, Tex.	***	*
Lamb, Tex.	***	*
Oldham, Tex.	***	*
Parmer, Tex.	*****	***
Randall, Tex.	***	***
Sherman, Tex.	***	*
Swisher, Tex.	***	*
Chaves, N. Mex.	***	***
Curry, N. Mex.	*****	***
DeBaca, N. Mex.	***	*
Guadalupe, N. Mex.	*	-
Harding, N. Mex.	***	***
Lea, N. Mex.	***	*
Quay, N. Mex.	*****	***
Roosevelt, N. Mex.	*****	***
Union, N. Mex.	***	*
Overall DDA	*****	***

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[1] - = No impact.
* = Low impact (a county with a low level of construction activity, no major pollutant sources, no construction camp, and not within a significant distance of Class I or nonattainment areas).
*** = Moderate impact (a moderate level of construction activity, or pollutant sources within a significant distance of Class I or nonattainment areas).
***** = High impact (a high level of construction activity, and/or a construction camp within a significant distance of Class I nonattainment areas, or major pollutant sources).

primary concern in the deployment area during the short and long-term. Fugitive dust emissions from construction activity and from the stationary sources that process construction materials at the construction camp will cause excessive localized particulate concentrations. Preliminary evidence indicates that elevated NO_x levels are due to the generators located at construction camps, however, precise quantification is not possible because of insufficient source data. All counties with one or more construction camps received a moderate to high impact rating for the short-term.

Construction of the operating bases will cause significant localized elevated particulate concentrations, therefore, the counties with operating bases (Curry, New Mexico and Hartley, Texas) were considered to be high impact areas during the short-term. Curry and Hartley counties received long-term moderate impact ratings because of increased CO concentrations expected from vehicles and space heating and cooling. The particulate nonattainment areas in Eddy County, which is south of and adjacent to Lea County, did not affect ratings for Lea County because of the transport distance and the southerly prevailing winds. M-X system impacts on existing and proposed Class I areas of White Mountain, Pecos, Wheeler Peak, and Capulin Mountain, New Mexico, were reflected in higher ratings assigned to counties within 100 mi of the Class I areas.

6.9 ALTERNATIVE 8

The split-basing alternative is identical in level of impact to portions of the Proposed Action and Alternative 7. See Table 6.9-1 for the impact significance of the DDA and the operating bases. Impacts described for the Coyote Spring primary operating base site in the Proposed Action and for the Clovis primary operating base site in Alternative 7 were considered to be identical at this level of analysis. Counties and hydrographic basins containing the M-X system were assigned the same level of impact ratings as were previously assigned, except when the density of M-X system activity was altered.

Table 6.9-1. Direct impact to air quality in the Nevada/Utah and Texas/New Mexico DDAs for Alternative 8.

Hydrologic Subunit or County No.	Name	Short Term Impacts[1]	Long Term Impacts[1]
	Subunits or Counties with M-X Clusters and DTN		
4	Snake, Nev./Utah	***	*
5	Pine, Utah	***	***
6	White, Utah	***	*
7	Fish Springs, Utah	-	-
46	Sevier Desert, Utah	***	*
46A	Sevier Desert-Dry Lake, Utah[3]	***	*
54	Wah Wah, Utah	*****	***
155C	Little Smoky-South, Nev.	***	*
156	Hot Creek, Nev.	***	***
170	Penoyer, Nev.	*****	***
171	Coal, Nev.	*****	***
172	Garden, Nev.	*****	***
173AB	Railroad-North & South, Nev.	***	*
180	Cave, Nev.	***	***
181	Dry Lake, Nev.[3]	*****	***
182	Delamar, Nev.	***	***
183	Lake, Nev.	***	***
184	Spring, Nev.	***	*
196	Hamlin, Nev./Utah	*****	***
202	Patterson, Nev.	***	*
207	White River, Nev.	***	*
210	Coyote Spring[2]	*****	*****
	Bailey, Tex.	***	*
	Castro, Tex.	*	-
	Cochran, Tex.	***	***
	Dallam, Tex.	***	***
	Deaf Smith, Tex.[3]	*****	***
	Hartley, Tex.	*****	***
	Hockley, Tex.	***	*
	Lamb, Tex.	***	*
	Oldham, Tex.	***	*
	Parmer, Tex.	*	-
	Randall, Tex.	*	-
	Sherman, Tex.	*	-
	Swisher, Tex.	*	-
	Chaves, N. Mex.	***	***
	Curry, N. Mex.	*****	***
	DeBaca, N. Mex.	***	*
	Harding, N. Mex.	***	***
	Lea, N. Mex.	***	*
	Quay, N. Mex.	***	***
	Roosevelt, N. Mex.[3]	***	***
	Union, N. Mex.	***	*
	Overall DDA Impact	*****	***

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[1] - = No impact.
* = Low impact.
*** = Moderate impact.
***** = High impact.

[2] Does not contain M-X clusters or DTN.

[3] Conceptual location of Area Support Centers (ASCs).

7.0 VISIBILITY

An increasingly important air quality concern in the western United States, where scenic topographic features and excellent visual range produce numerous exceptional vistas, is the issue of visibility impairment. Public interest in the visibility issue has grown in recent years leading to the initiation of various monitoring and modeling studies. Concern over possible decreases in visibility is also reflected in the Clean Air Act Amendments of 1977 which contain provisions for the protection of visibility in federally-mandated Prevention of Significant Deterioration (PSD) Class I areas. Final rulemaking on visibility protection for Federal Class I areas was signed by the EPA administrator in November, 1980 to be effective January 2, 1981. In addition, some states have promulgated standards designed to maintain good visibility.

At this date, Nevada is the only state in the two M-X basing regions that has an ambient visibility standard. The standard is exceeded when pollutant concentrations reduce the prevailing visibility to less than 30 mi when the humidity is less than 70 percent. Prevailing visibility is defined as the greatest visibility which is attained or surpassed around at least half of the horizon circles, but not necessarily in continuous sectors. Both Nevada and Utah have some form of visible emission standard. These regulations generally apply only to smoke or combustion-related stationary sources.

Visibility and visibility impairment can be defined in several ways. The most common index of visibility is visual range, which is defined as the farthest distance from which one can see a large black object against the horizon. However, the ability to discern colors and the color contrast of objects such as distant mountains, clouds, and the sky is also an important visual index. Impairment of visibility can be defined as the reduction of visible range or atmospheric discoloration. Visibility impairment produced by human activities is generally defined as one of three types: (1) widespread regional haze which reduces visibility in every direction, (2) plumes of gaseous and particulate emissions that obscure the sky, horizon, or terrain near large pollutant sources (plume blight), and (3) layers of discoloration appearing above the surrounding terrain. EPA has defined anthropogenic visibility impairment as any humanly perceptible change in visual range, contrast, atmospheric color, or other convenient visibility measure from that which would have existed under natural conditions. The principal anthropogenic contributor to visibility impairment in the M-X deployment area will be primarily particulate matter in the form of fugitive dust released during the construction phase of the project.

In Section 169(a) of the Clean Air Act (as amended in 1977) Congress established as a national goal "the prevention of any future and remedying of any existing impairment of visibility in mandatory Class I federal areas, which impairment results from man-made air pollution." The Act required that EPA promulgate a list, compiled by the Department of Interior and other federal land managers, of mandatory Class I federal areas in which visibility is an important value. This list was promulgated in 1979 and contained 156 of the 158 Class I areas. EPA is also mandated to promulgate regulations which provide guidelines to the states on appropriate techniques for implementing the national visibility goal and to require that states incorporate into their State Implementation Plan (SIP's) measures needed to make reasonable progress towards this goal. The guidelines must require existing

major stationary sources that impair visibility to install the best available retrofit technology (BART) and that SIP's include a long-term strategy towards meeting visibility goals.

It is important to note that emissions may not have to be transported into a Class I area to cause visual impact in that area. Visibility protection also applies to views of landscape features outside the area that are considered by the federal land manager to be an integral part of the Class I area experience.

The federal land managers have defined the nature of visibility impairment in the Class I areas as well as the potential sources of this impairment. The status of regions corresponding to the Nevada/Utah siting region is summarized in Table 7.0-1. Present visibility problems in the Nevada/Utah region appear to be related more to visible plumes and plume discoloration than to regional haze. Dust releases during intense periods of M-X construction would tend to contribute to a regional haze effect rather than a plume impact.

In addition to dust releases, other anthropogenic contributions to visibility impairment during M-X construction and operation will result from the emission of pollutant precursors by vehicles, generators, and OB facilities. Pollutant precursors are converted in the atmosphere into secondary species such as nitrogen dioxide gas (from emissions of nitric oxide), sulfate particles (from SO_x emissions), nitrate particles (from NO_x emissions), and organic particles (from hydrocarbon emissions). Gases and particulates cause visibility impairment by scattering and absorbing visible light. Light scattering by particles is the most important cause of degraded visual air quality. Fine solid or liquid particles between 0.1 to 1.0 micrometers are the most efficient light scatterers per unit mass. Absorption however, is only weakly dependent on particle size (Figure 7.0-1). Scattering and absorption by aerosol clouds and gases depends on the wavelength of the incident light, the angle of observation, and the concentration and size distribution of the molecule.

Visibility within pristine Class I areas is highly sensitive to incremental additions of fine particles as illustrated in Figure 7.0-2. However, the most noticeable impact in these long visual range areas will be perceived as the reduction in apparent contrast. A change in visual range from 350 km to 250 km will not be as perceptible to the human eye as a change in contrast of a distant target with the background sky. In viewing remote objects through the daylight atmosphere, contrasts in both luminance and chromaticity are reduced due to light from the sun and sky being scattered into the eyes of the observer by particles within the atmosphere (including molecules of atmospheric gases). The addition of this sky light to the observer's field-of-view causes an object of any color to appear nearly achromatic (colorless) as its contrast with the background falls to a low value. The object "blends" with the background and can no longer be recognized (Middleton, 1952).

The perceived color of objects and sky is also changed by the addition of aerosols to the atmosphere. In general, the color of viewed objects tends to fade toward that of the horizon sky as distance from observer to target is increased. Thus, the overall effect of increased aerosol loading (particulates and gas molecules) in the atmosphere due to M-X sources will be a combination of reduced visual range, reduced contrast, and "washout" of color. It is anticipated that these effects will be most noticeable during the construction phase of the project.

7.0-1. Nature of visibility impairment in the Nevada/Utah siting region.

Region	Reported Visibility Status	Observed Visibility Phenomena	Potential Sources: Man-made	Potential Sources: Natural	Potential Future Impairment
Southeast Nevada -Southwest Utah	Some impairments, need to assess noted.	1. Haze (intermittent) 2. Visible plumes 3. Discoloration (brown, yellow, bands)	1. Power plants smelters, urban plumes 2. Power plants, miscellaneous small sources	1. Natural haze 2. Wild-fires	Possible decrease in smelter impacts. Significant population growth in Utah.

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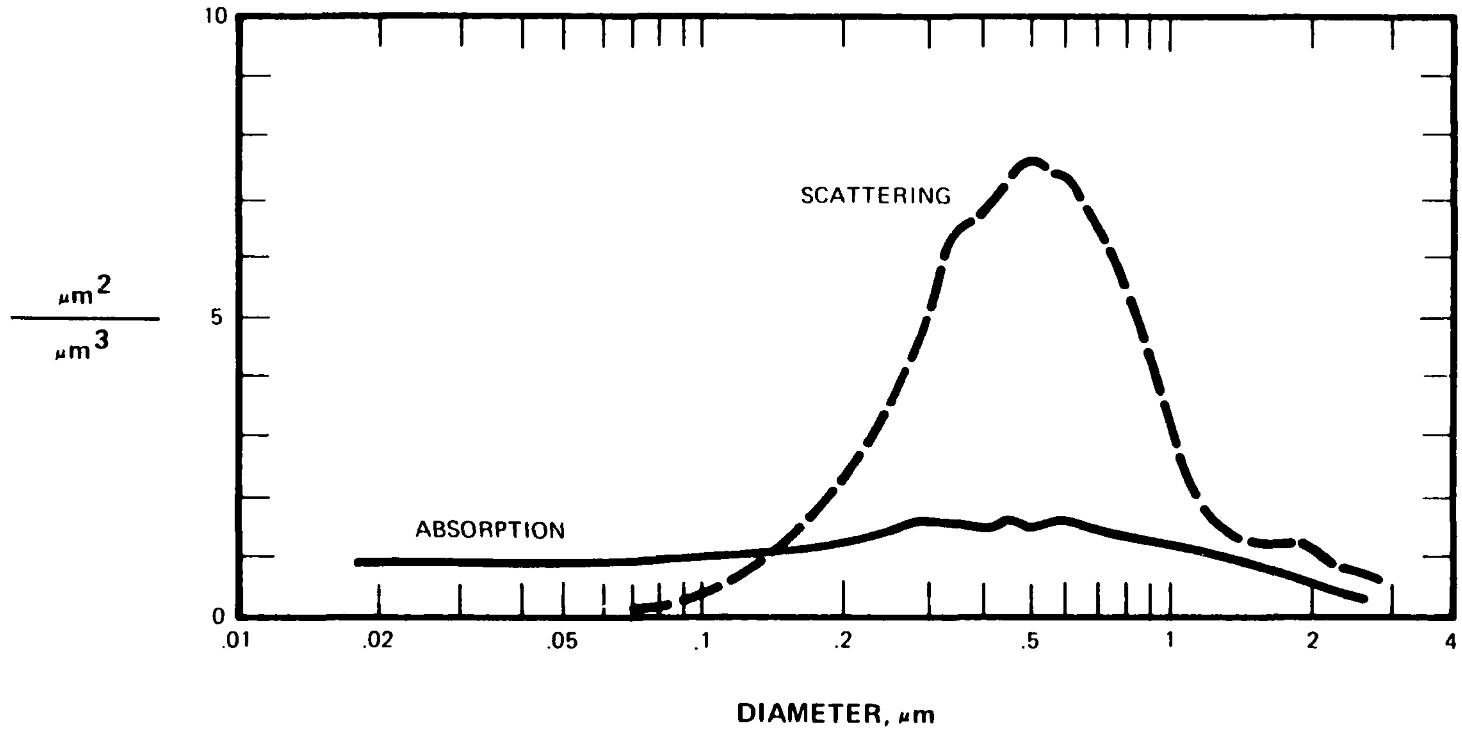

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Figure 7.0-1. Light scattering and absorption efficiency per unit value of particle as a function of particle size (Charlson et al, 1978).

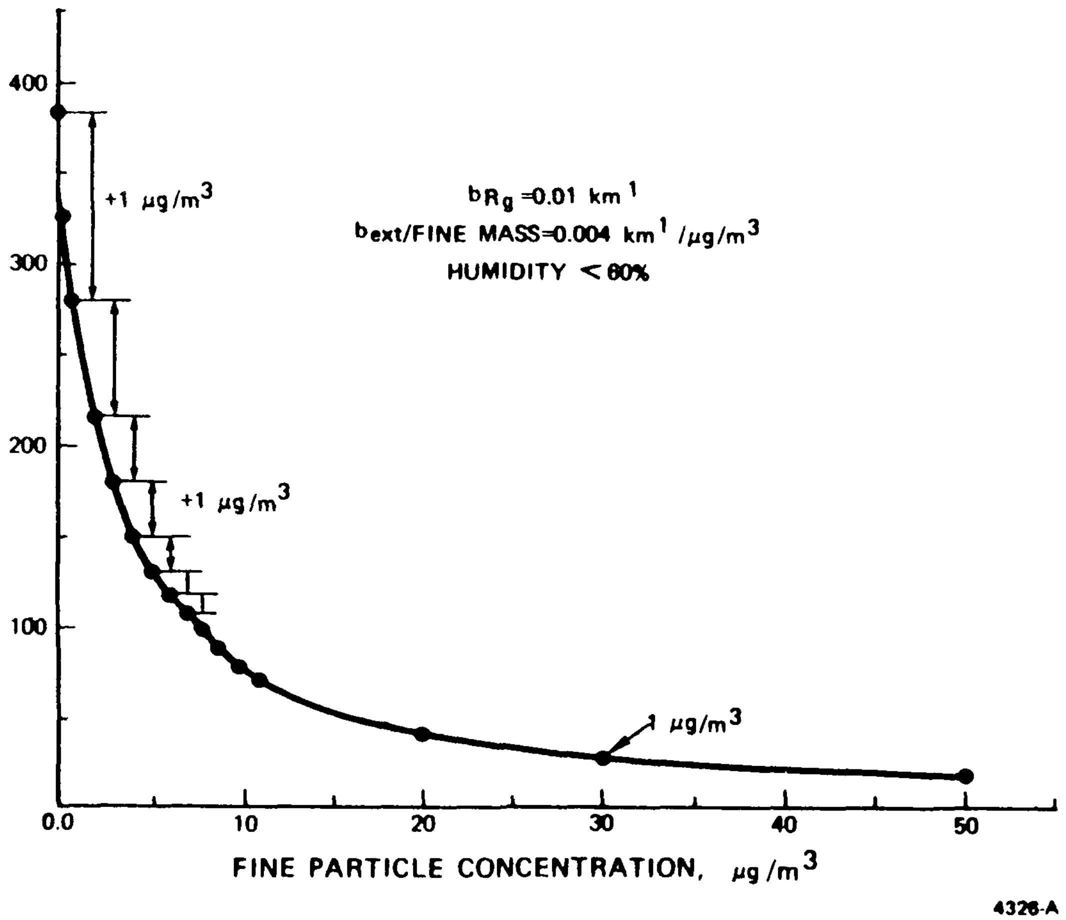

Figure 7.0-2. Effects of fine particle increments on calculated visual range. Addition of 1 $\mu g/m^3$ on a clean atmosphere reduces visual range by 30 percent. Addition of the same amount when background visual range is 35 km (20 mi) produces a 3 percent reduction.

Detailed visibility modeling will be required to determine if any impact from long-term OB operation will occur. This modeling would take place during the site-specific phases of the tiered EIS evaluation process.

7.1 BASELINE VISIBILITY

The most commonly measured or observed index is visual range, which is routinely tabulated at many airports. A map of medium annual visual range appears in Figure 7.1-1. The map is based on a limited number of data points, but is sufficient to show the generally high visual range of greater than 70 mi (110 km) that occurs in Nevada and Utah, (Trijonis and Shapland, 1978g). A report by the U.S. Department of the Interior (USDI, 1979) states that visibilities in the nonurban areas of the southwestern United States are approximately 65 to 80 miles. Measurements at Cedar Mountain, Utah, using photographic photometers have shown visibility ranges from 54 to 94 miles (USDI, 1979). A separate study at Cedar Mountain performed by the Air Resources Laboratory of the National Oceanic and Atmospheric Administration, (Pueschel and Allee, 1980), reported annual means of 80 miles from the photographic method, and 100 miles from telephotometry with a photopic filter. Figure 7.1-2 shows the average monthly visual ranges derived from the photographic method (Vrp) and from telephotometry (Vrt).

Despite the fact that visibility is still quite good in the west and southwest United States relative to the rest of the country, visibility has been deteriorating. Comparison of visibility data in the southwest for the 1950's to data for the 1970's shows substantial decreases for both urban and nonurban locations (Trijonis and Yuan, 1977). At Ely, Nevada, the visual range decreased 42 percent during the period 1954 to 1971 (Figure 7.1-3). Decreases have been experienced in extremely remote areas. It has been suggested that the reason for this general regionwide decrease is the increasing regional levels of secondary aerosols such as sulfates and nitrates (Trijonis and Yuan, 1977) in the atmosphere.

Much of the visibility reduction experienced in the western and southwestern United States may be traceable to power plants, mining, smelting, and urban pollutants. However, fugitive dust has been shown to be a significant contributor to the atmospheric turbidity problem at times (Hall, 1980). Wind blown dust due to very strong winds can cause as much as 70 percent reduction in visual range on winter mornings and late afternoons, and as much as 90 percent reduction on summer mornings (Cramer et al., 1978).

Any of the M-X activities that disturb the native, arid surface such as road building, aggregate material mining, and facilities construction will contribute to the blowing dust problem until such time as adequate revegetation or surface cover can be established. It is known from investigations by Clements (Clements et al, 1963), that undisturbed arid surfaces do not produce much atmospheric dust until wind speeds on the order of 15 m/s (34 mph) are experienced, but when surfaces are disturbed the wind speeds required to generate blowing dust are significantly lower. Table 7.1-1 shows the results of the study and highlights the difference in winds for crusted and loose surfaces.

In areas such as the Texas panhandle, large quantities of dust can be stirred up by agricultural plowing and harrowing during late spring. The amount of dust generated is dependent upon wind, soil composition, and soil moisture. Application

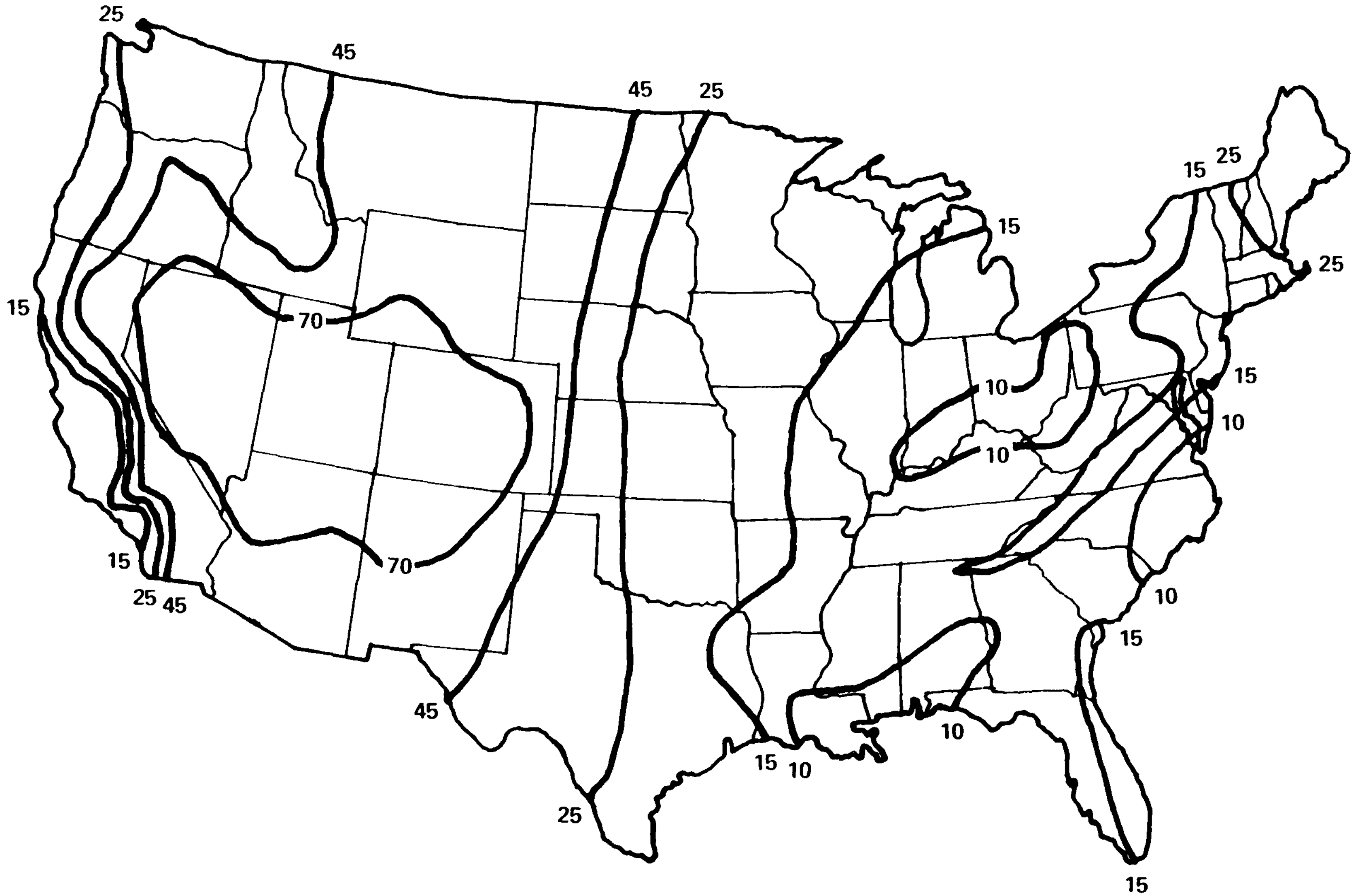

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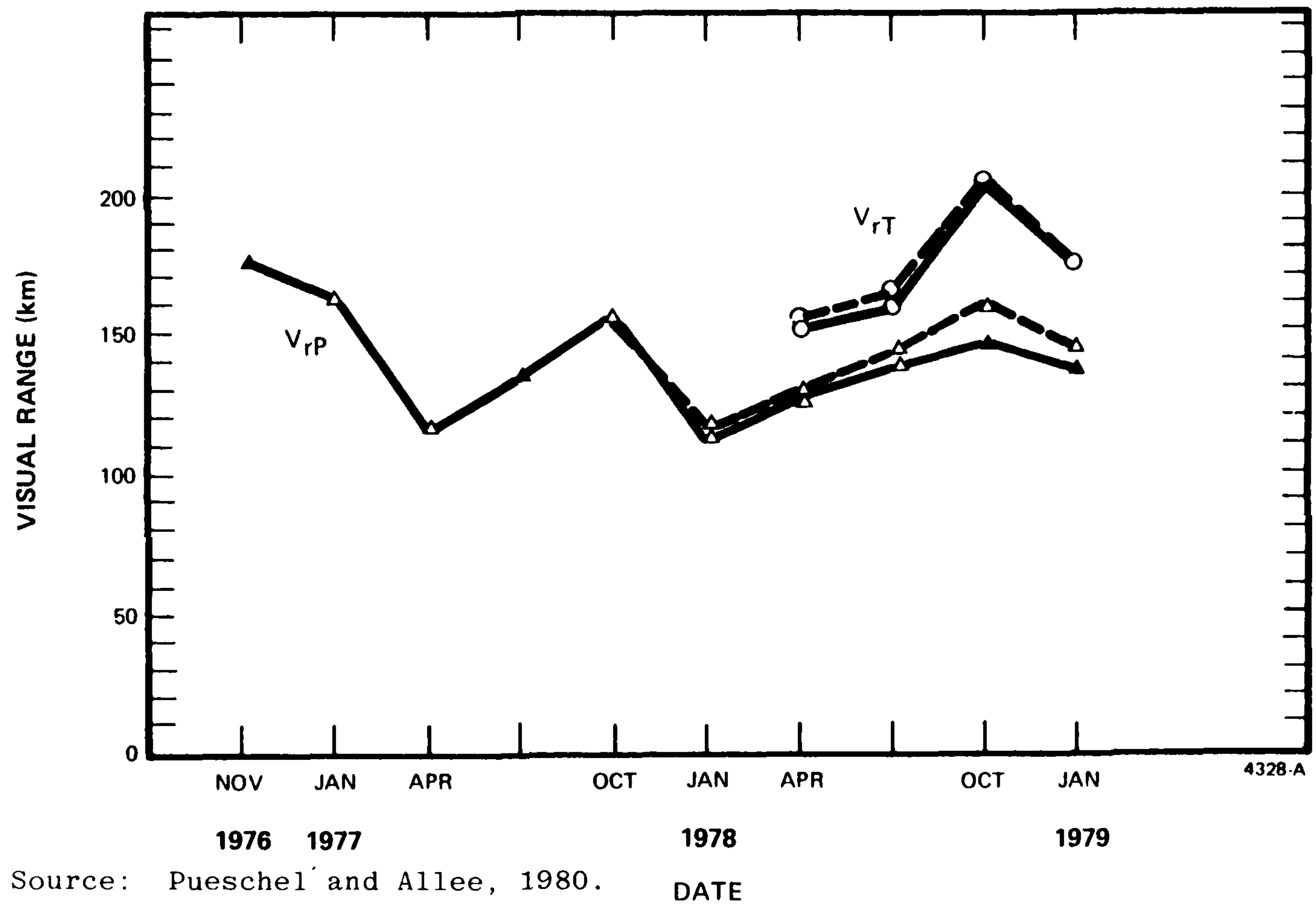
Figure 7.1-1. Median yearly visual range (miles) for suburban/non-urban areas, 1974-1976.



Source: Pueschel and Allee, 1980.

Figure 7.1-2. Monthly averages of visual ranges derived from the photographic (V_{rP}) and telephotometric (V_{rT}) methods between November 1976 and January 1979. (Dashed line indicates incorporation of an additional target.)

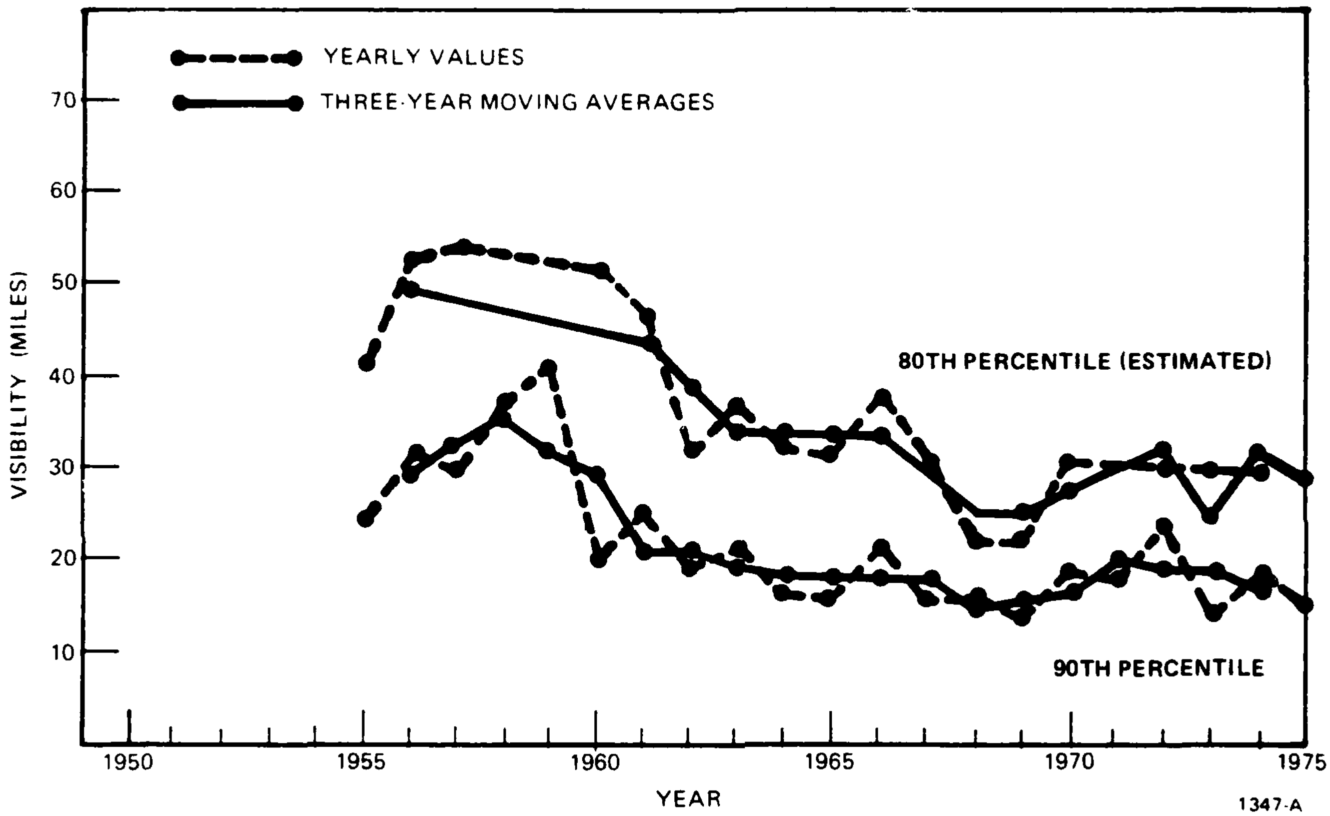


Figure 7.1-3. Long term visibility trends at Ely, Nevada (Trijonis and Yuan, 1977).

Table 7.1-1. Minimum wind speed required to generate blowing dust for various arid surfaces (after Clements et al. 1963).

Surface Type	Minimum Wind m/s
Playa (dry lake), undisturbed	15
Alluvial fan, crusted	16
Alluvial fan, loose material	9
Desert pavement, mature	16
Desert pavement, partially formed	8
Dry wash	10
Desert flat, partial vegetation	11
Sand dunes	6

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of erosion models would be necessary to determine concentration levels of blowing dust which may affect visibility. Likewise, road dust emission equations related to vehicular traffic will have to be solved prior to visibility modeling in order to determine vehicle dust concentration inputs.

7.2 VISIBILITY MODELING

A basic premise of the Clean Air Act Amendments of 1977, as reflected in the final rule-making on visibility protection for federal Class I areas, is that the effects of man-made air pollutants on visual range and atmospheric discoloration can be identified. However, a review of state-of-the-art knowledge concerning concepts of visibility reveals that the theory of visual detection of objects as seen through the atmosphere is quite complex. The questions of how far one can see through the atmosphere, or what one can see at a given distance, are not the subject of optical physics alone. The amount and distribution of artificial and natural light, the characteristics of the objects looked at, and the properties of the human eye itself all play a part in the determination of atmospheric "visibility." Nonetheless, despite the complexities involved, predictive models have been, and continue to be, developed. These predictive models are necessary to evaluate the effects of controls on existing pollutant sources and the potential impacts of proposed new sources.

Visibility models to date basically utilize dispersion and transformation features of other air pollution impact models to predict the concentrations of particulates and aerosols across the line of sight path. Optical equations are then applied to the concentrations to predict resultant visibility impacts. In order to quantify the effect, the modeling procedure relates changes in light scattering and absorption to changes in contrast, which will be perceived as changes in visibility.

Ideally, visibility models will be developed to handle all three major types of impairment: plume blight, layers of discoloration, and regional haze. However, the regional haze problem presents some difficult obstacles which must be overcome prior to development of a worthwhile model; i.e., large-scale meteorological processes responsible for the regional transport of pollutants are poorly understood, the definition of boundary conditions is uncertain, and inventories of natural and anthropogenic emission sources are inadequate. Background inventories are especially lacking in the southwest areas of Nevada and Utah.

Models for the prediction of regional haze effects would be of more benefit than plume models for a project such as M-X which will release more pollutants from areawide sources as opposed to point sources. Emission contributors such as the materials batch plant, construction camp generators, OB cooling/heating plants, etc., will have minor effect as compared to the construction dust and vehicle emissions. However, these point sources would be modeled with plume visibility models in the site-specific tier of the EIS evaluation process, whereas availability of an applicable regional haze model is questionable. It is important to note that many uncertainties in common to all visibility models exist such as:

1. Prediction of atmospheric dispersion characteristics become less reliable as distance from the source increases. Complex terrain (commonly found near most of the Class I area) is not accounted for.

2. Chemical transformation and removal processes for sulfur and nitrogen oxides are difficult to predict under varying environmental conditions.

3. Baseline conditions must presently be derived from rough estimates for Class I areas rather than from monitoring programs.

4. The models cannot account for uncertainties in the current understanding of human visual perception and the optical characteristics of air pollutants.

5. Visibility models have generally not been verified through intensive monitoring programs. Major experimental efforts are currently underway to confirm the theoretical predictions of present models.

In addition to the above-mentioned uncertainties, the regional models are subject to significant lack of information regarding meteorological data such as knowledge of diurnal patterns in mixing heights, turbulence, stagnation, recirculation, channeling by terrain, and moderate- to large-scale meteorological patterns of wind flow. For these reasons, no regional air quality models are available for assessing visibility impacts on a large scale which do not require further refinement and validation before they can be used for regulatory applications. Determination of appropriate methods to use in evaluating the potential regional impact will require consultation with and input from the EPA and federal land managers. Feasible methods, as identified, would be implemented for inclusion of results in the final phases of the EIS process.

7.3 VISIBILITY MONITORING

Monitoring would be necessary to establish baseline levels of visibility against which the impact from M-X potential sources of degredation may be evaluated. A complete monitoring program would require measurement of optical parameters, meteorological variables, pollutant concentrations, pollutant size distributions, and scenic characteristics. Currently, an extensive visibility network in Class I areas in the West is being conducted by EPA and the National Park Service.

The most important optical parameters to be measured are the apparent contrast of distant objects and the extinction coefficient, a parameter related to the light scattering and absorption characteristics of the atmosphere. A multiwavelength telephotometer can be used to measure the apparent contrast between a target and the horizon, and is very useful over long path lengths up to 50-100 km. A transmissometer measures transmission and extinction of light over a fixed path of 10-20 km. A nephelometer would be used to measure light scattering by particles at a single point and give estimates of extinction coefficient.

EPA guidelines recommend that a comprehensive visibility monitoring program include:

(1) baseline meteorological monitoring conducted for a year or more;

(2) visibility monitoring including color photography, human observation, integration nephelometer, and a multiwavelength telephotometer; and

(3) evaluation of anthropogenic and natural source/receptor relationships including a two-stage size-segregating particulate sampler or other device compatible with fine particulate mass and compositional analysis, meteorological measurements, and nitrogen dioxide monitor.

The most substantial visibility monitoring program to date has been the National Weather Service hourly visual range observations. These observations are useful in identifying trends at particular locations. However, more accurate optical measurements and additional air quality parameters are necessary for visibility modeling and source identification. A major instrumental monitoring program was begun in 1976 by National Oceanic and Atmospheric Administration (NOAA) and EPA designed to study visibility, air quality, and meteorological variables in the Cedar Mountain, Utah Class I area. The actual site is north of several major Class I areas in southeast Utah. Many measurements were taken and much of the data is still being analyzed. The general conclusion thus far is that northerly air masses bring in cleaner air than masses from other directions, causing baseline visibility to vary dramatically.

The Cedar Mountain Study has been incorporated into EPAs project VIEW (Visibility Investigative Experiment in the West), which is operating in the Southwest. The VIEW program is a prototype visibility monitoring network with 14 sites each set up to record telphotometer readings of apparent contrast of different targets in different directions. Some of the sites are outfitted with additional devices such as nephelometers, particle samplers, photographic cameras, and meteorological instruments. Most of the sites are operated by personnel of the National Park Service, who also record visual observations.

Data from the VIEW network is currently being processed. Preliminary results appear similar to those reported at Cedar Mountain. Passages of weather systems from the Pacific northwest are closely correlated with better visibility, measured as increasing target contrast.

Visibility monitoring is also planned by the Electric Power Research Institute, the National Park Service, the Tennessee Valley Authority, and other groups. Most of these projects are now in the planning or initiation stage.

7.4 POTENTIAL VISIBILITY IMPACTS OF M-X OPERATION

Despite the current lack of an accepted model to address the impacts to visibility of a regional source such as the M-X system, a first-order estimation of the effect of system operation on visibility in PSD Class I areas was performed. This analysis was intended to identify the approximate magnitude of potential visibility impacts.

An analysis of the annual impact of wind erosion emissions from Pine and Wah Wah Valleys on Zion and Bryce Canyon National Parks was carried out using the ISCLT Model. This effort is described in Section 8.4 and the model results given in Table 8.4-2. Data on the particle size distribution of the modeled TSP concentrations at Bryce Canyon and Zion are not available. However, numerous investigations per unit mass of nonsulfate, nonnitrate TSP in the southwest and Great Plains have been made. The EPA Report to Congress on Protecting Visibility indicates

that estimates of this parameter range between 0.0002 and 0.0008 $km^{-1}/(\mu g/m^3)$. Another report (Trijonis and Yuan, 1977) reports a range of 0.0001 to 0.0005 $km^{-1}/\mu g/m^3$) for areas of the rural Southwest.

If it is assumed that the M-X-generated suspendible wind erosion emissions are of similar characteristics as nonsulfate, nonnitrate TSP in the southwest, an estimate of visibility impact can be made. This is accomplished through the use of the Koschmieder formula

$$V = \frac{3.92}{B}$$

where: V = visual range (km)
B = extinction coefficient (km^{-1}).

This formula assumes a threshold of perception for a dark target to be at a contrast of 0.2. The extinction coefficient can be expressed as

$$B = B_{Rg} + B_{ag} + B_{scat} + B_{ap}$$

where: B_{Rg} is Rayleigh scattering by air molecules
B_{ag} is absorption by NO_2 gas
B_{scat} is scattering by particles
B_{ap} is absorption by particles.

The B_{scat} term tends to be the major portion of the total extinction.

If the baseline visual range is known, then the Koschmieder formula can be used to calculate the baseline extinction coefficient. Using an estimate of extinction per unit mass of TSP, the effect of an incremental increase of TSP on the extinction coefficient, and hence on visual range, can be calculated. This, of course, requires the assumption that there is no other change in pollutant concentrations of sulfates, nitrates, or gases that absorb or scatter light. The results of such an analysis, using the long-range transport calculations described in Section 8.4, appear in Table 7.4-1. An extinction coefficient per unit mass of 0.0005 $km^{-1}/(\mu g/m^3)$ was chosen as being a worst case for a rural location. Calculations were made for both the long-range model case assuming settling of particles and the case assuming no settling of particles. The wind erosion emissions were assumed to be unmitigated.

The results in Table 7.4-1 indicate an absolute worst case annual visibility decrease of 21.5 percent at Zion and 14 percent at Bryce Canyon. However, using the more reasonable assumptions of allowing particle settling and removal, the effect upon annual visual range is extremely small. Obviously, more detailed analysis needs to be done both in simulating long-range transport processes and in identifying the size distribution of the emitted and transported wind erosion particles. Also, it is recognized that impacts on annual visibility may not be the most appropriate yardstick for evaluating overall visibility impacts. Depending on the perceived asthetic values of a given Class I area, a more appropriate measure of impact might be the increase in number of days that a distant scenic vista is not visible. Site-specific issues such as this, as well as more detailed assessment of visibility impacts, would be carried out in future tier studies.

Table 7.4-1. Potential Impacts on visual range in Bryce Canyon and Zion resulting from wind erosion in Pine and Wah Wah Valleys.

Location	Model Assumption[1]	Annual TSP Concentration (ug/m^3)	Annual Baseline Visual Range[2]	Impacted Visual Range	Percent Decrease
Bryce	No settling and removal of particles	6.9	186 km	160 km	14
	Settling and removal assumed	0.3	186 km	185 km	1
Zion	No settling and removal of particles	11.4	186 km	146 km	21.5
	Settling and removal assumed	1.1	186 km	181 km	3

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[1]See Section 8.4 and Table 8.4-1 for particle settling and removal assumptions.

[2]Visual range for Bryce Canyon taken from: Malm, W.C., et al., Visibility in the Southwestern United States from Summer 1978 through Spring 1979, preprints on Visibility: Measurements and Model Components, Symposium on Plumes and Visibility, Grand Canyon, 1980. Annual visual range at Zion was assumed to be the same as at Bryce Canyon.

8.0 LONG-RANGE TRANSPORT

8.1 SIGNIFICANCE OF LONG-RANGE TRANSPORT

The M-X system, in both the Nevada/Utah and Texas/New Mexico basing areas, extends over an extremely large region. Air pollutant emissions will occur over a large portion of the basing region during system construction, and over the entire basing region during system operation. The extremely large scale over which emissions will occur could produce a situation in which there is a substantial cumulative impact of these emissions downwind of the system as a result of long-range atmospheric transport.

During construction, particulate emissions will occur as a result of activities such as earth moving, sand and gravel processing, and vehicles moving over unpaved surfaces. The emissions will occur primarily at those clusters undergoing construction, but wind erosion emissions will continue to occur from disturbed surfaces at clusters already completed. Gaseous emissions (NO_x, CO, HC, SO_x), as well as additional particulate emissions will occur from construction vehicles and the generators used to provide power for material processing activities.

During operation of the M-X system, most of the emissions will occur at the operating base. The emission sources will include vehicles, space heating, aircraft, fuel storage, and possibly a central cooling and heating facility (CCHF). Fugitive dust emissions from disturbed surfaces will occur throughout the deployment area during operation. Additionally, dust emissions will result from vehicles moving over unpaved cluster roads.

There are several potential impacts of the long-range (over 50 km) transport of these emissions. Emissions during M-X operation could impact on PSD Class I areas such as Zion and Bryce Canyon in Utah and Pecos and Wheeler Peak in New Mexico. At this point it is not certain whether or not PSD regulations will apply to construction emissions which may continue for more than two years. It is possible that some construction emissions may be subject to PSD review, particularly if the emissions come from a new major stationary source.

Long-range transport of particulates as well as transport of secondary aerosols (sulfates and nitrates) from combustion products (SO_x and NO_x) can contribute to a decrease in regional visibility. Currently, there are no federal regulations dealing with the regional haze phenomenon, however, current federal regulations mandate the protection of "integral vistas" in PSD Class I areas from plume blight resulting from stationary point sources. It is possible that at a future date regulations will be promulgated by EPA to deal with regional haze. At the present time the state of Nevada has an ambient visibility standard. This standard is exceeded when pollutant concentrations reduce the prevailing visibility in any direction from the observer to less than 30 mi when the relative humidity is less than 70 percent. Regional pollutant concentrations resulting from M-X emissions could significantly reduce prevailing visibility in Nevada, where the average annual ambient visibility is currently as good as any location in the United States (greater than 70 mi).

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8.2 FACTORS INFLUENCING LONG-RANGE TRANSPORT

There are numerous factors that determine the magnitude of the contribution of long-range transport to regional air pollutant concentrations within and downwind of the M-X basing region. The characteristics of the emission sources are an extremely important consideration. These include emission rates, height of release, and the geographic distribution of the various individual sources. These parameters will be influenced by system configuration and the construction schedule. The emission of fugitive dust due to wind erosion will be controlled by the total area of disturbed surfaces as well as, to a large extent, by the low level wind speed.

The vertical flux of pollutant emitted from near the surface up into the mixed atmospheric layer will determine how much pollutant is available for long- range transport. This is controlled by the local winds and stability. In the Nevada/Utah basing region there is a definite influence produced by the valley and ridge topography. At night cold air drainage from the mountains into the valleys restricts the vertical dispersion of pollutants. During the morning and daytime hours, inversions can exist at the top of the ridges which effectively "cap" the valleys and restrict the transport of pollutants out of the valleys.

Once the pollutant has been mixed vertically and is available for long-range transport, its dispersion is controlled chiefly by the large-scale transport winds in the mixed layer. In both basing regions, the predominant direction of large-scale transport winds is from west to east. Thus, it is the areas to the east of each basing region that have the greatest potential to be affected by the long-range transport of pollutants.

Gaseous pollutants and particulates are removed from the atmosphere during transport by several mechanisms. Gaseous pollutants can undergo chemical transformations in the atmosphere which convert them to other gaseous species or to secondary particulates such as sulfates and nitrates. Both gaseous pollutants and particulates can be removed from the atmosphere through wet and dry deposition processes. Dry deposition can be enhanced in rough terrain areas. The removal of larger particles can occur due to gravitational settling. This is especially the case for particles with diameters greater than 20μ. Therefore, particle size distribution of the emission sources is an extremely important factor in determining the amount of particulates transported large distances from the sources.

8.3 LONG-RANGE TRANSPORT MODELING APPROACHES

Analysis of air quality problems over horizontal scales of 20 km to 2000 km make use of dispersion models known as "regional" models (Drake, et al., 1979). There are currently three separate classes of regional scale simulation models: grid, particle, and trajectory models. Of these three approaches, the majority of development and use has centered on trajectory models.

Trajectory models simulate the transport and diffusion of pollutant plumes in time and space as a result of varying wind fields. Trajectory models use two- or three-dimensional wind fields as input, which are either interpolated from observations or generated with a dynamic prediction model. These models are more appropriate for long-range calculations than Gaussian models because they provide a better definition of plume location. Trajectory models simulate plume transport by

either a continuous plume, or a series of moving boxes or puffs. Lateral plume spread can be defined by either a uniform or a Gaussian distribution. Similarly, the vertical distribution of pollutants can be defined by Gaussian relationships: either be assumed uniform throughout the mixed layer, or be calculated through eddy diffusivity and gradient transfer relationships.

Trajectory models have been used to calculate short-term (24 hours or less) pollutant concentration estimates, but in general are more appropriate for evaluating longer-term averages. This is primarily because of the lack of spatial meteorological data and the inherent errors in resulting trajectory calculations. For longer-term (monthly or longer) calculations, errors in plume location calculations tend to be smoothed out.

For long-term averages, some trajectory models calculate a concentration distribution for each time-step (usually 3 to 6 hours) in the simulation (Hefter, 1975). However, another approach calculates a long-term concentration based on trajectory statistics and the assumption that the lateral spread of pollutants can be calculated by considering the statistical distribution of trajectory locations at each time-step (Shannon, 1979).

A second class of models appropriate for use in long-range transport calculations are grid models. These models are based on solving the transport and diffusion equations by finite difference approximations. The models will compute concentrations over an entire grid network, not just along given trajectories. Grid models are generally used to calculate short-term concentrations of pollutants in urban areas, deep valleys, and mountains. These models are effective for simulating the effects of terrain on atmospheric transport. A disadvantage of grid models is the large amount of computer time and storage needed to run them, as well as the need for considerable meteorological data to effectively make use of the model sophistication.

Another type of regional model is the particle model. Particle models are hybrid Lagrangian/Eulerian models, which follow the path of a pollutant through an Eulerian (fixed point) grid. The fixed grid divides physical space into cells and the particles carry pollution from cell to cell based on a wind field consisting of the true velocity field plus a turbulent flux velocity field. In order to accurately predict concentrations, it is necessary to use a large number of particles in each grid cell. This implies a large amount of computer time and storage.

The long-range transport models described above have definite advantages over a Gaussian approach for regional scale simulations. These models allow for spatially and temporally variable winds rather than using the steady-state Gaussian assumption. These models are also much more appropriate for rough terrain situations as terrain effects are reflected in the wind fields in the models.

However, long-range transport models have a number of deficiencies as well. The lack of abundant meteorological input data in some cases limits the ability to effectively use the models. Sophisticated modeling techniques are useless unless the input data is sufficient to warrant their sophistication. Long-range transport models in general suffer from a lack of model verification with measured data. Thus, it is extremely difficult to identify error bands for the concentration estimates made with these models. This is a particular shortcoming if direct comparison with an air quality standard is necessary.

8.4 POTENTIAL IMPACTS ON PSD CLASS I AREAS

Despite the lack of an available, sophisticated model to evaluate long-range transport impacts of fugitive dust emissions, a first-order analysis was applied to wind erosion emissions. This analysis focused on the potential long-term impacts of the long-range transport of wind erosion emissions from disturbed surfaces on the air quality and visibility in PSD Class I areas. The purpose of this analysis was to estimate the potential magnitude of long-range transport impacts and to identify the need for future work in this area.

The analysis consisted of the application of the Industrial Source Complex Long-Term (ISCLT) model to the wind erosion emissions from disturbed surfaces in two valleys: Pine and Wah Wah Valleys in Utah. The impact of these emissions on two PSD Class I areas, Zion National Park and Bryce Canyon National Park, was calculated. These particular valleys and PSD Class I areas were chosen because they represented the closest proximity of the M-X system to Class I areas and because meteorological data from Milford, Utah indicate a significant frequency of winds towards these Class I areas. The meteorological data used as input to the ISCLT model consisted of a relative frequency distribution of wind speed, wind direction, and stability class for Milford, which is just to the east of Pine and Wah Wah Valleys. These data (STAR data) were prepared at the National Climatic Center and represent an annual average of conditions over a period of 3½ years.

Wind erosion emissions were based on a determination of the amount of disturbed surface area as well as worst and best case climatic and soil erodibility assumptions for the Nevada/Utah siting area (Section 4.1.2.1.5). The wind erosion emissions calculated consist only of "suspendible" particles. It was assumed that only particles less than 30 microns in diameter can be considered as suspendible. Wah Wah Valley was assumed to cover the entire extent of construction group 4 whereas Pine Valley contains approximately 40 percent of construction group 3. The two valleys were divided up into a total of 11 area sources, each with a dimension of 20 km by 20 km. The emission for each grid square was calculated based on the total number of shelters, miles of cluster roads, and miles of DTN road located within the boundaries of the square.

The ISCLT model is a Gaussian, steady-state model that computes monthly, seasonal, or annual concentrations. It does not account for terrain effects on the wind field. It cannot account for wet deposition of particles, but does contain the option to calculate the effect of dry deposition of particles. This is accomplished through inputing a particle size distribution, a characteristic fall velocity for each particle size category, and a surface reflection coefficient for each size category. Model runs were made assuming both no settling or removal of particles as well as settling and removal of particles. The assumed characteristics of the suspended wind erosion emissions are contained in Table 8.4-1.

Model calculations of the impact of wind erosion emissions from Pine and Wah Wah Valleys on Zion and Bryce Canyon were made for numerous combinations of assumptions. The options included worst case and best case assumptions on soil and climate, settling and removal of particles versus no settling and removal, and various degrees of emission mitigations. The model results are summarized in Table 8.4-2.

Table 8.4-1. Assumed characteristics of suspended wind erosion particles.[1]

Particle Size Category (μm)	Mass Mean Diameter (μm)	Mass Fraction	Settling Velocity (m/sec)	Reflection Coefficient
0 - 10	6.30	0.1	0.001	1.00
10 - 20	15.54	0.55	0.007	0.82
20 - 30	25.33	0.31	0.019	0.72

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[1] Values presented here represent ore pile and conveyor belt particulate emissions data (for particles less than 30 μm) as described in the "Industrial Source Complex Dispersion Model (ISC) User's Guide," Volume I, 1979.

The results in this table indicate that for the worst case assumptions on climate and soils and the assumption of no settling, the PSD Class I increment of 5 $\mu g/m^3$ is exceeded at both Zion and Bryce Canyon. However, when settling of particles is assumed, the concentrations for all model runs are less than 1 $\mu g/m^3$ at the two Class I areas. The concentrations at Zion are considerably larger than at Bryce Canyon due to its closer proximity to Pine and Wah Wah Valleys (88 km versus 110 km for Bryce) and the greater frequency of winds in its direction. It is apparent that the inclusion of increasing degrees of emission mitigation effectively minimizes impacts. However, it is also evident that the magnitude of impacts is extremely sensitive to the precise soil and climate conditions in the source area.

This initial analysis of long-range transports indicates that impacts on Class I areas could be significant under certain conditions. However, much additional analysis needs to be performed to adequately address the issue. The impact of the entire M-X system on Class I areas needs to be analyzed. The use of data pertaining to surface as well as upper air winds at multiple stations in the basing area is necessary to properly describe the transport and dispersion of wind erosion emission.

8.5 FUTURE WORK

Several contributing tasks will be necessary to quantify the impacts of long-range transport. It will be necessary to better quantify the emission sources associated with the M-X project, especially for fugitive dust resulting from wind erosion. A significant portion of this effort will be spent in estimating the particle size distributions of the various particulate emission sources. Differences in soil characteristics between portions of the basing regions need to be identified. Construction schedules and the level of activity in each portion of the M-X region need to be carefully defined so that emissions can be accurately predicted in space and time.

The primary purpose of the long-range transport analysis will be to assess the long-term impacts of wind erosion from disturbed surfaces and other emissions during the M-X system operation. In particular, the impacts of long-range transport on PSD increments and regional visibility will be analyzed. Those sources from the system construction that will be subject to PSD review will be evaluated in separate long-range transport calculations.

Table 8.4-2. Annual TSP impacts on PSD Class I areas from wind erosion in Pine and Wah Wah valleys.

Model Run	Soil and Climate Assumption[1]	Gravitational Settling and Removal of Particles[2]	Amount of Emissions Mitigation[3] (Percent)	Annual TSP Concentration (ug/m^3) Zion	Bryce
1	Worst case	No	0	11.4	6.9
2	Worst case	No	20	9.1	5.5
3	Worst case	No	50	5.7	3.6
4	Worst case	No	80	2.3	1.4
5	Worst case	Yes	0	1.1	0.3
6	Worst case	Yes	20	0.88	0.24
7	Worst case	Yes	50	0.55	0.15
8	Worst case	Yes	80	0.22	0.06
9	Best case	No	0	1.4	0.87
10	Best case	No	20	1.1	0.70
11	Best case	No	50	0.7	0.44
12	Best case	No	80	0.28	0.17
13	Best case	Yes	0	0.14	0.04
14	Best case	Yes	20	0.11	0.03
15	Best case	Yes	50	0.07	0.02
16	Best case	Yes	80	0.03	0.01

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[1]Worst case implies C' = 200 and I' = 235 tons/acre/year.
Best case implies C' = 100 and I' = 86 tons/acre/year.
(See Section 4.1.2.1.5)

[2]Assume particle characteristics appear in Table 8.4-1.

[3]Mitigations are assumed to be uniformly effective across each source grid square input to the model. No specific mitigations are assumed, but they could consist of minimizing the amount of disturbed area, revegetation, or other measures.

9.0 IMPACTS ON LAS VEGAS VALLEY

Although it is outside the M-X basing regions, Las Vegas Valley in Clark County, Nevada will be impacted by M-X construction and operation. Basing of the system in Nevada/Utah will result in an increase in population in Clark County, and will be made up of primarily construction support personnel and their dependents. This increase will be the greatest if the OB is sited at Coyote Spring.

The population increase (with M-X versus without M-X) in Clark County, assuming the OB at Coyote Spring, will be rapid, reaching a peak in 1986 (Table 9.0-1). After 1986, the percent population increase due to M-X falls from a peak of 7.7 percent to 2.3 percent in 1993. This latter figure represents the percent of population living in Clark County as a result of the OB operation.

The Las Vegas Valley Basin portion of Clark County is currently designated as nonattainment for primary national ambient air quality standards (NAAQS) for carbon monoxide (CO), ozone (O_3), lead (Pb), and total suspended particulates (TSP). As part of the Nevada State Air Quality Implementation Plan (SIP), an Air Quality Implementation Plan (AQIP) for Las Vegas Valley was developed in 1978 and revised in 1980. The AQIP represents a local air quality management strategy to meet the TSP and Pb standards by 1982 and the CO and O_3 standards by 1987. However, the growth of population due to M-X system construction and operation could interfere with the efforts to reach attainment, particularly since the peak population influx to Clark County is between 1982 and 1987.

The most serious air quality problem in Las Vegas Valley is that of carbon monoxide. The eight-hour standard (40 mg/m^3) for carbon dioxide is exceeded frequently in the Las Vegas Valley during the winter months. The primary source of carbon monoxide emissions is motor vehicles, which constitute over 90 percent of the Valley's emissions. Therefore, the plan for attainment of the CO standard reflects an emphasis on mobile source rather than stationary source controls.

An increase in population in the Las Vegas Valley resulting from M-X system construction will result in additional vehicle miles traveled and carbon monoxide emissions. The potential for this situation interfering with the attainment of the CO standard in 1987 is summarized in Table 9.0-2. This table indicates that the increased population may cause the Las Vegas Valley to fall almost 4,000 tons/year short of its CO attainment emission level in 1987 if emission reduction programs are not expanded. It is not apparent whether or not this will result in the CO standard not being attained in 1987. The CO nonattainment problem in Las Vegas is primarily occurring in localized "hot spots" in the center of the city. The increased population due to M-X will likely be located in the northerly fringe areas of Las Vegas and not contribute to a large increase in vehicle miles traveled in the center of the city. An increase in valley-wide CO emissions that occurs in the fringe areas will not have a major effect on the downtown hot spots.

It is unlikely that traffic commuting to the operating base or the operating base emissions themselves will significantly impact the downtown hot spots. The prevailing wind direction during winter months, when the CO standard is most often violated, is from the southwest. The Coyote Spring OB is located to the northeast of Las Vegas and hence will not significantly effect the air quality of Las Vegas.

Table 9.0-1. Population impacts in Clark County, Nevada of Proposed Action.

Year	Baseline	With M-X	Difference	Percent Increase Over Baseline
1982	495,378	496,630	1,252	0.3
1983	512,955	526,884	13,929	2.7
1984	531,154	554,167	23,013	4.3
1985	550,000	587,701	37,701	6.9
1986	571,110	614,988	43,878	7.7
1987	593,040	636,489	43,449	7.3
1988	615,800	650,623	34,823	5.7
1989	639,450	663,283	23,833	3.7
1990	663,990	680,878	16,888	2.5
1991	683,250	699,584	16,334	2.4
1992	703,050	719,681	16,631	2.4
1993	723,440	740,387	16,947	2.3
1994	744,410	761,694	17,284	2.3

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Table 9.0-2. Comparison of total on-road mobile CO emissions and emission reductions in 1987 for Las Vegas Valley with and without M-X.[1]

	CO Emissions, Emission Reductions (tons/year)		
	Without M-X	With M-X	
Projected Baseline Emissions (without AQIP)	72,000	77,250[2]	
Emission Reductions (AQIP)			
Enhanced Inspection/Maintenance	23,040	23,040	(24,720)[3]
Carpooling/Ridesharing	1,440	1,440	(1,545)
Traffic Flow Improvement	3,600	3,600	(3,860)
Transit Improvements	2,160	2,160	(2,320)
Total Reductions	30,240	30,240	(32,445)
Projected CO Emissions (AQIP)	41,760	47,010	(44,805)
Attainment Emission Level	43,000	43,000	(43,000)
Projected minus Attainment Emissions	-1,240	+4,010	(+1,805)

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[1]Assumes proposed action: full deployment - Nevada/Utah and OB at Coyote Spring.

[2]Assumes a linear increase in vehicle miles traveled and emissions with population (7.3% population increase in 1987).

[3]Numbers in parentheses indicate possible emissions/reductions if it is assumed that all control measures are expanded linearly with the expanded population.

The probable worst case effect of the M-X population increase would be to delay attainment of the CO standard for a year or two. After 1987, the percent of population increase due to M-X decreases rapidly to 2.4 percent in 1991 and stays at approximately that number. The effect of this lower population increase would be to increase CO levels a small amount. It is unlikely that attainment of the standard would be hindered as vehicle emission reductions should increase year by year.

Las Vegas Valley currently violates the National Ambient Air Quality Standard for lead, set at 1.5 $\mu g/m^3$ for a calendar quarter. Virtually all of the lead emissions are from mobile sources. However, due to federally enforced control strategies such as improved fleet fuel economy requirements, a decline in lead content in gasoline resulting from a lead phase-down in gasoline, and fewer engines using leaded gasoline, the Valley is projected to be in attainment by 1982. In fact, by 1982, emissions in Las Vegas Valley are projected in the AQIP to be less than half of the level required to attain the standard. The maximum M-X population increase in Clark County is 7.7 percent in 1986. This increase will in no way jeopardize attainment of the lead standard.

The potential impact of the M-X on the TSP and ozone standards is uncertain. Because of the preponderance of fugitive and natural sources of particles in the Valley (Table 9.0-3) and the likelihood of an imminent revision in the TSP standard, the AQIP identifies no control strategy for this pollutant. EPA staff has recommended revising the TSP standard to a size-related particle standard that would only apply to smaller, respirable particles (Environmental Reporter, 1981). If such a standard is promulgated it is likely that the Las Vegas Valley will no longer be a nonattainment area for particles since fugitive dust tends to consist in larger particles. Emissions from the M-X population increase should not substantially increase respirable particle levels.

The ozone nonattainment problem in Las Vegas Valley is extremely localized. The Valley is effectively in attainment with the ozone standard, with the exception of the industrial complex in Henderson, Nevada, also known as the Southeast Valley Area. The AQIP recommends that Las Vegas Valley be reclassified by EPA from nonattainment for ozone to unclassified. The AQIP also recommends that the Southeast Valley phenomena be further studied to determine the nature of the nonattainment problem.

Ozone problems are usually linked to the emissions of ozones main precursor pollutants, reactive hydrocarbons and nitrogen oxides. Vehicle emissions associated with the population increase and the Coyote Spring OB will result in an increase in concentration of these pollutants. The impact on ozone levels should be to increase them somewhat, however, the magnitude of the increase is uncertain and depends on complexities of source distribution, atmospheric transport, and photochemistry. If most of the M-X population increase occurs towards Coyote Spring to the north of Las Vegas, it is unlikely that the increased vehicle emissions will have much of an effect on Henderson due to the prevailing southwesterly winds in the area.

Table 9.0-3. Particulate emission inventory for Las Vegas Valley (units are tons per year).

	1979	1982
A. Chemical Process	50	51
B. Metallurgical		
1. Titanium	53	54
2. Manganese Dioxide	22	23
C. Mineral & Mining		
1. Gravel Mining	86	88
2. Gravel Crushing & Screening	912	938
3. Lime Mfr.	90	92
4. Asphalts Plants	35	36
5. Concrete Ready Mix	22	23
D. Large Appliance Mfr.	22	23
E. Combustion of Fuels		
1. Power Plants	195	195
2. Large Commercial	23	25
3. Residential & Small Commercial	39	44
4. Other Industrial	15	16
5. Fireplaces	60	65
F. Fugitive Dust		
1. Fires	52	52
2. Cleared Areas	2,200	2,101
3. Construction & Demolition	14,700	14,700
4. Unpaved Roads	7,700	9,235
5. Paved Roads	10,600	12,682
6. Other Area Sources	550	550
7. Natural Sources (Desert)	5,304	5,088
G. Aircraft	141	155
H. Motor Vehicles		
1. On-Road	1,540	1,892
2. Off-Road	240	267
I. Railroads	63	63
Total	44,714	48,458

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Source: Air Quality Implementation Plan, Las Vegas Valley, Clark County, Nevada, Revised: November 18, 1980.

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